Fishery Data Series No. 99-19

Sport Fishing Effort, Catch, and Harvest, Fishery Contributions, and Inriver Abundance of Chilkat River Chinook Salmon near Haines, Alaska, in 1998

by

Randolph P. Ericksen

August 1999

Alaska Department of Fish and Game **Division of Sport Fish**

Symbols and Abbreviations

The following symbols and abbreviations, and others approved for the Système International d'Unités (SI), are used in Division of Sport Fish Fishery Manuscripts, Fishery Data Series Reports, Fishery Management Reports, and Special Publications without definition. All others must be defined in the text at first mention, as well as in the titles or footnotes of tables and in figures or figure captions.

Weights and measures (metric)

centimeter	cm
deciliter	dL
gram	g
hectare	ha
kilogram	kg
kilometer	km
liter	L
meter	m
metric ton	mt
milliliter	ml
millimeter	mm

Weights and measures (English)

cubic feet per second	ft^3/s
foot	ft
gallon	gal
inch	in
mile	mi
ounce	oz
pound	lb
quart	qt
yard	yd

Spell out acre and ton.

Time and temperature

day	d
degrees Celsius	°C
degrees Fahrenheit	°F
hour (spell out for 24-hour clock)	h
minute	min
second	s

Spell out year, month, and week.

Physics and chemistry

all atomic symbols	
alternating current	AC
ampere	A
calorie	cal
direct current	DC
hertz	Hz
horsepower	hp
hydrogen ion activity	pH
parts per million	ppm
parts per thousand	ppt, ‰
volts	V
watts	W

General

All commonly accepted abbreviations.	e.g., Mr., Mrs., a.m., p.m., etc.
All commonly accepted professional titles.	e.g., Dr., Ph.D., R.N., etc.
and	&
at	@
Compass directions:	
east	E
north	N
south	S
west	W
Copyright	©
Corporate suffixes:	
Company	Co.
Corporation	Corp.
Incorporated	Inc.
Limited	Ltd.
et alii (and other people)	et al.
et cetera (and so forth)	etc.
exempli gratia (for example)	e.g.,
id est (that is)	i.e.,
latitude or longitude	lat. or long.
monetary symbols (U.S.)	$, ¢
months (tables and figures): first three letters	Jan,...,Dec
number (before a number)	# (e.g., #10)
pounds (after a number)	# (e.g., 10#)
registered trademark	®
trademark	™
United States (adjective)	U.S.
United States of America (noun)	USA
U.S. state and District of Columbia abbreviations	use two-letter abbreviations (e.g., AK, DC)

Mathematics, statistics, fisheries

alternate hypothesis	H_A
base of natural logarithm	e
catch per unit effort	CPUE
coefficient of variation	CV
common test statistics	F, t, χ^2, etc.
confidence interval	C.I.
correlation coefficient	R (multiple)
correlation coefficient	r (simple)
covariance	cov
degree (angular or temperature)	°
degrees of freedom	df
divided by	÷ or / (in equations)
equals	=
expected value	E
fork length	FL
greater than	>
greater than or equal to	≥
harvest per unit effort	HPUE
less than	<
less than or equal to	≤
logarithm (natural)	ln
logarithm (base 10)	log
logarithm (specify base)	$\log_2$, etc.
mideye-to-fork	MEF
minute (angular)	'
multiplied by	x
not significant	NS
null hypothesis	H_O
percent	%
probability	P
probability of a type I error (rejection of the null hypothesis when true)	α
probability of a type II error (acceptance of the null hypothesis when false)	β
second (angular)	"
standard deviation	SD
standard error	SE
standard length	SL
total length	TL
variance	Var

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SPORT FISHING EFFORT, CATCH, AND HARVEST, FISHERY CONTRIBUTIONS AND INRIVER ABUNDANCE OF CHILKAT RIVER CHINOOK SALMON NEAR HAINES, ALASKA, IN 1998

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ABSTRACT

The chinook salmon *Oncorhynchus tshawytscha* sport fishery in Chilkat Inlet and the escapement into the Chilkat River were studied to add to the understanding of this important sport fishery and the salmon stock which supports it. A mark-recapture experiment was used to estimate spawning abundance of chinook salmon age 1.3 and older returning to the Chilkat River in 1998. Angler effort and harvest of wild mature chinook salmon in the Haines marine boat fishery were estimated using a creel survey. Harvest of large (>28 inches in total length) chinook salmon and chartered angler effort and harvest were also estimated. Contributions of brood year 1991 Chilkat River chinook salmon to sport and commercial fisheries in Alaska were estimated from recoveries of coded wire tags.

Two hundred thirty-one (231) large (age 1.3 and older) chinook salmon were captured with drift gillnets and fish wheels, in the lower Chilkat River between June 11 and August 4, 1998; 227 of these fish were tagged with solid-core spaghetti tags. We examined a total of 531 large chinook salmon on spawning tributaries to the Chilkat River, and 32 of these were marked. On the basis of these data, we estimated that 3,675 (SE = 565) large chinook salmon immigrated into the Chilkat River during 1998.

An estimated 8,200 angler-hours (SE = 747) of effort (7,546 targeted salmon hours; SE = 747) were expended for a harvest of 215 (SE = 56) large chinook salmon, of which 153 (SE = 51) were wild mature fish. Chartered anglers accounted for 39% of the targeted salmon effort and 17% of the harvest of large chinook salmon.

The harvest of 1991 brood year Chilkat River chinook salmon in the common property fisheries over all years was estimated at 1,139 (SE = 215). The vast majority of this harvest occurred in the inside waters of northern Southeast Alaska. Reasons why this estimate is considered low are discussed.

Key words: mark-recapture, creel survey, angler effort, harvest, marine boat sport fishery, hatchery, escapement, coded wire tag, age composition, length-at-age, chinook salmon, *Oncorhynchus tshawytscha*, Chilkat River, Kelsall River, Tahini River, Big Boulder Creek, Haines, Southeast Alaska.

INTRODUCTION

The purpose of this study was to monitor the sport harvest and escapement of chinook salmon *Oncorhynchus tshawytscha* returning to the Chilkat River during 1998. The long-term goal of this study is to develop maximum harvest guidelines for this stock in accordance with sustained yield management.

The Chilkat River is a large glacial system that originates in British Columbia, Canada, flows through rugged, dissected, mountainous terrain, and terminates in Chilkat Inlet near Haines, Alaska (Figure 1). The mainstem and major tributaries comprise approximately 350 km of river channel in a watershed covering about 1,600 km² (Bugliosi 1988).

The Chilkat River produces the third or fourth largest run of chinook salmon in Southeast Alaska (Pahlke 1997). Previous studies indicate that Chilkat River chinook salmon rear primarily in the inside waters of northern Southeast Alaska (Pahlke 1991, Johnson et al. 1993, Ericksen 1996). Electrophoretic analysis indicates that this population may be more closely related genetically to southern British Columbia and Washington stocks than to other Southeast Alaskan populations (Gharett et al. 1987).

A spring marine boat sport fishery occurs annually in Chilkat Inlet (Figure 1) in Southeast Alaska near Haines and targets mature chinook salmon returning to the Chilkat River. A creel survey has been used to monitor harvest in this fishery since 1984. The harvest in this fishery peaked at over 1,600 chinook salmon in 1985 and 1986 (Neimark 1985; Mecum and Suchanek 1986, 1987; Bingham et al. 1988; Suchanek and Bingham 1989, 1990, 1991; Ericksen 1994, 1995, 1996, 1997, 1998).

The spring marine boat fishery in Haines has been popular both with local and non-local anglers; an estimated 61% of the anglers who

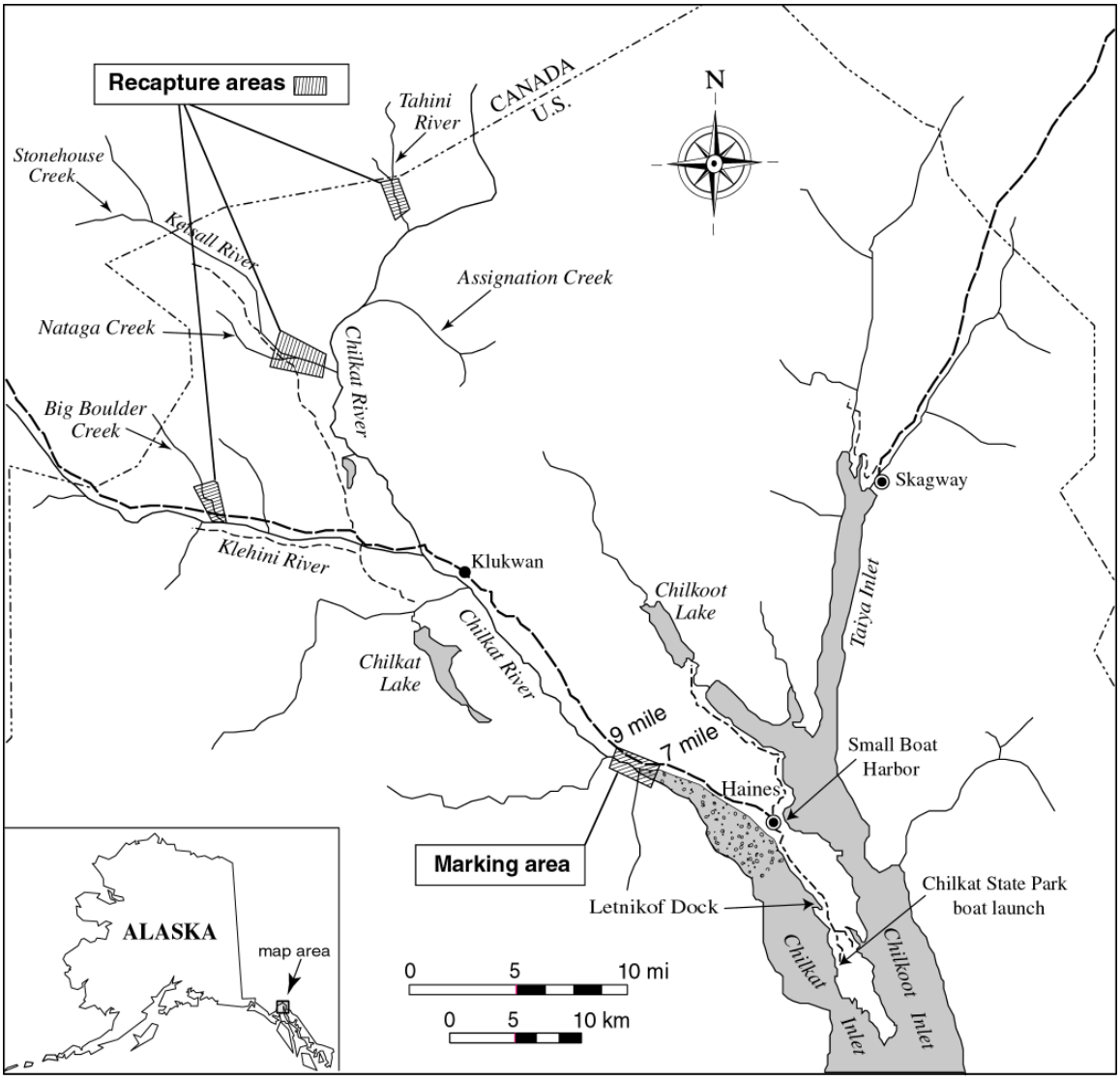

Figure 1.–Location of sampling sites and release sites of coded wire tagged chinook salmon near Haines and Skagway, Southeast Alaska, 1998.

fished in 1985 were not from Haines (Bethers 1986). In 1988, anglers fishing in Haines and Skagway for chinook salmon spent an estimated $1.1 million (Jones and Stokes 1991). The Haines King Salmon Derby, which began in the mid 1950s, is directed primarily at returning Chilkat River chinook salmon.

Beginning in 1981, the Alaska Department of Fish and Game (ADF&G), Division of Sport Fish began a program to index chinook salmon abundance in the Chilkat River (Kissner 1982) using aerial survey counts in Stonehouse and Big Boulder creeks (Figure 1). These areas were selected because they were the only clearwater spawning areas that could be effectively surveyed. The indices were used in a regionwide program to monitor chinook salmon escapements in Southeast Alaska (Pahlke 1992).

Concern about Chilkat River chinook salmon developed when the indices of adult abundance declined in 1985 and 1986. This decline coincided with high harvests of chinook in the

commercial troll, commercial drift gillnet, and marine sport fisheries in the area. In 1987, the Department began to restrict sport, subsistence and commercial fisheries in upper Lynn Canal, and recreational fisheries were closed entirely in 1991 and 1992. The Haines King Salmon Derby was closed beginning in 1988.

As a result of these concerns, the Division of Sport Fish initiated a program to tag wild juvenile chinook salmon in 1988 with coded wire tags (CWTs) to identify migratory patterns and to estimate contributions to sport and commercial fisheries. The Division of Sport Fish also conducted radio telemetry and mark-recapture experiments in 1991 and 1992, to estimate spawning distribution and abundance of large (age 1.3 years and older) chinook salmon in the river. Results of this research indicated that most of the chinook spawn in two major tributaries of the Chilkat River, the Kelsall and Tahini rivers, and immature fish are harvested as they rear in the inside waters of Southeast Alaska (Johnson et al. 1992, 1993; Ericksen 1996).

Mark-recapture experiments have been conducted annually since 1991 to estimate the escapement of large chinook salmon. Estimates have ranged between 4,472 (SE = 851) and 8,100 (SE = 1,193) fish (Johnson et al. 1992, 1993; Johnson 1994; Ericksen 1995, 1996, 1997, 1998). Because abundance has appeared relatively high and stable, a King Salmon Derby was held in Haines during 1995, for the first time in eight years, and continues to the present.

The current Chilkat River escapement goal of 2,000 chinook salmon was established in the late 1970s and is currently under review. Regulations in effect during 1998 prevented sport fishing for chinook salmon near the mouth of the Chilkat River (see Ericksen 1998, Figure 2). At its spring 1997 meeting, the Alaska Board of Fisheries (BOF) repealed the seasonal limit of two chinook salmon. At the same meeting, however, the BOF limited nonresident anglers to an annual limit of four chinook salmon in Southeast Alaska. Commercial fishing regulations are structured to reduce incidental harvests of mature chinook salmon in the Lynn Canal gillnet fishery.

Estimating harvest and escapement is the continuing goal of the Chilkat River chinook salmon research program.

Research objectives in 1998 were:

1. to estimate the 1998 immigration of large (≥ age 1.3) chinook salmon into the Chilkat River;
2. to estimate the age and sex compositions of the escapement of large chinook salmon in the Chilkat River;
3. to estimate the harvest of wild mature chinook salmon in the Haines spring marine boat sport fishery from May 11 to June 28, 1998; and,
4. to estimate the harvest of 1991 brood year Chilkat River chinook salmon in randomly sampled fisheries.

METHODS

INRIVER ABUNDANCE

A mark-recapture experiment was used to estimate the number of large (≥age 1.3) chinook salmon returning to the Chilkat River in 1998. Marks were applied to fish (≥440 mm FL) captured in the lower Chilkat River with drift gillnets and fish wheels from June 8 through August 4, between the area adjacent to Haines Highway miles 7 and 9 (Figure 1). Chinook salmon were marked with a solid-core spaghetti tag, and a hole punch in the upper left operculum, prior to release. Water depth (cm), and temperature (°C) were recorded daily at 0700 and 1330 hours near highway mile 8. Fish were examined for marks on three spawning tributaries of the Chilkat River between August 2 and September 5.

Lower River Marking

Gillnets 21.3 m long and 3.0 m deep (70 ft x 10 ft) were drifted in the lower Chilkat River, from June 12 through July 18, 1998. The gillnets consisted of two equal-length panels: one with 17.1-cm (6.75-in.), and the other with 20.3-cm (8.0-in.) stretched nylon mesh. These nets were

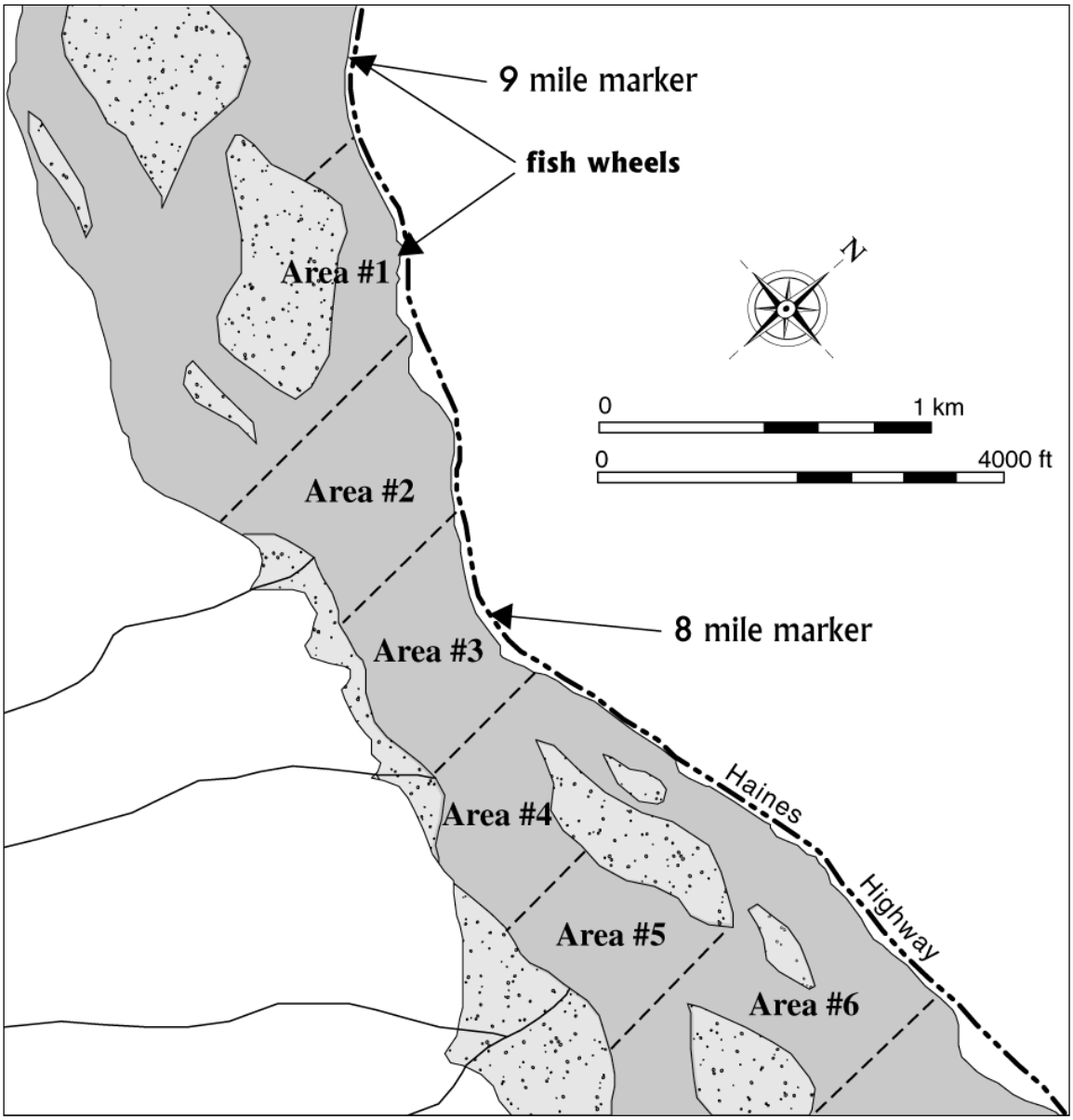

Figure 2.–Active river channel of the lower Chilkat River, drift gillnet areas, and sites of fish wheels in 1998.

used because the 18.5-cm (7.25-in.) stretched nylon mesh used in previous years was not available. Each day an attempt was made to complete 43 drifts between 0600 and 1400 hours. Fishing was conducted from an 18-ft boat in six adjoining 0.5-km-long areas, which were marked along 3-km-long stretch of river (Figure 2). This area of the river was located slightly upriver from the area used in previous years due to shoaling. The section of the river used was about 100 m wide and 2 to 3 m deep. The 43 drifts took about 6 hours to complete when fish were not captured. Fishing continued uninterrupted from area 1 to area 2, and then to area 3 if fish were not captured. If a [0.5-km] drift was prematurely terminated because a fish was caught, or if the net became entangled or drifted into shallow water, the terminated drift was

subsequently completed before a new drift was started. If 43 drifts could not be completed during the day, additional drifts were added to the next day's total to make up the balance.

Two three-basket aluminum fish wheels were installed by ADF&G Commercial Fisheries Division (CF) personnel early in the season to monitor the escapement of sockeye salmon *O. nerka* to the Chilkat River. The Division of Sport Fish provided funding for one technician to work on the fish wheels in exchange for CF tagging of captured chinook. One fish wheel operated adjacent to the Haines Highway near mile 9 from June 9 through October 13, and another from June 8 through October 2 about 300 m downstream (Figure 2). The wheels were located along the east bank of the river where the main flow was constrained primarily to one side of the floodplain. Fish wheels operated continuously except for maintenance.

Captured chinook salmon were placed in a water-filled tagging box (see Figure 3 *in* Johnson 1994), inspected for missing adipose fins, and measured to the nearest 5 mm, mid-eye-to-fork length (MEF). Fish were initially classified as "large," "medium," or "small," depending on their length: fish ≥660 mm MEF were designated as large, fish <660 and ≥440 mm MEF as medium, and fish <440 mm MEF as small. Healthy chinook salmon ≥440 mm MEF were scale sampled, visually "sexed," and marked with a uniquely numbered spaghetti tag threaded over a solid plastic core, and a ¼-inch hole was punched into the upper edge of the left operculum as a secondary mark. Age of each fish was determined at the end of the season from scale pattern analysis (Olsen 1992). Each fish was then reclassified as large, medium, or small, using ocean age, rather than length, as criteria; fish with three or more ocean years of residence were classified as large, those with two ocean years as medium, and younger fish were classified as small. Any fish whose scales could not be aged was classified by length (as described above).

Spawning Ground Recovery

Escapements in the Kelsall and Tahini rivers (Figure 1) were sampled for marks by two teams of two people. Spawning grounds in the Kelsall River (including Nataga Creek) were sampled from August 2 to September 5. Spawning grounds in the Tahini River were sampled from August 3 to September 1. Chinook salmon were also sampled in Big Boulder Creek from August 6 through September 2. Chinook salmon were captured with gillnets, dip nets, bare hands, and spears. Double sampling was prevented by punching a hole in the lower edge of the left operculum of all captured fish.

The validity of the mark-recapture experiment rests on several assumptions: (a) that every fish has an equal probability of being marked during event 1, or that every fish has an equal probability of being captured in event 2, or that marked fish mix completely with unmarked fish; (b) that recruitment and "death" (emigration) do not both occur between sampling events; (c) that marking does not affect catchability (or mortality) of the fish; (d) fish do not lose marks between sample events; (e) all recovered marks are reported; and (f) that double sampling does not occur (Seber 1982).

The validity of assumption (a) was tested through a series of hypothesis tests. First, a 3×2 contingency table (chi-square statistic) was used to test the hypothesis ($\alpha = 0.05$) that fish sampled at the three spawning tributaries were marked at the same rate. If this hypothesis was accepted, a simple Petersen model was used to estimate abundance; otherwise a Darroch estimator would be used. Assumption (a) implies that tagging occurs in proportion to abundance during immigration or, if it does not, that no difference in the immigration timing, sex and age composition occurs between stocks bound for different spawning locations. The possibility of selective sampling was also investigated because assumption (a) could be violated if the sampling rate varied by size (or sex) of the fish. The hypothesis that fish of different sizes were captured with equal probability was tested with a Kolmogorov-Smirnov (K-S) 2-sample test comparing the size distribution of marked fish with those recaptured. Sex-selective sampling was tested by using a 2×2 contingency table to compare the number of males and females caught in the lower river with those caught on the spawning grounds. If selective sampling was

apparent the abundance estimate could be stratified by age and/or by sex. The remaining assumptions are considered in greater detail under the Discussion section.

Abundance (numbers immigrating) of large chinook salmon was estimated using the Chapman's modified Petersen estimator for a closed population (Seber 1982):

$$\hat{N} = \frac{(n_1+1)(n_2+1)}{(m_2+1)} - 1 \qquad (1)$$

$$var[\hat{N}] = \frac{(n_1+1)(n_2+1)(n_1-m_2)(n_2-m_2)}{(m_2+1)^2(m_2+2)} \qquad (2)$$

where n_1 is the number of large chinook salmon marked in the lower river, n_2 is the number of large chinook salmon examined on the spawning grounds, and m_2 is the number of marked fish recaptured on the spawning grounds.

Age and Sex Composition of the Escapement

Age and sex composition estimates can be biased due to sampling methods. Fish wheels can be selective for smaller fish (Ericksen 1995) and for males (Ericksen 1995, 1996, 1997, 1998) in some years. Carcass surveys are known to be selective for females in some situations (Pahlke et al. 1996). In addition, significant variation in age and/or sex compositions between spawning areas can bias composition estimates for the entire drainage.

All chinook salmon caught in the lower river and all live and dead chinook encountered on the spawning grounds were sampled, whenever possible, for age, length, and sex. Age compositions were tabulated separately for fish in the lower river gillnet, fish wheels, and in each escapement sampling location (tributary). Age composition, mean length-at-age, and variances of the catch in each gear type were calculated using standard normal statistics.

Age and sex selectivity was investigated by comparing the numbers of large (≥ age 1.3) by age and sex captured in gillnet and spawning ground samples with contingency table analysis (α = 0.1). Age (or sex) composition of the escapement was obtained from pooled samples when no selectivity was found, or from separate unbiased samples as appropriate. Proportions by age (or sex) were estimated by:

$$\hat{p}_a = \frac{n_a}{n} \qquad (3)$$

$$var[\hat{p}_a] = \frac{\hat{p}_a\,(1-\hat{p}_a)}{n-1} \qquad (4)$$

where p_a is the proportion in the population in age/sex group *a,* n_a is the number in the sample belonging to group *a*, and *n* is the number in the sample that are successfully aged (or sexed).

The abundance at age of chinook salmon in the escapement was estimated as:

$$\hat{N}_a = \hat{N}\,\hat{p}_a \qquad (5)$$

$$\text{var}[\hat{N}_a] = \text{var}[\hat{p}_a]\hat{N}^2 + \text{var}[\hat{N}]\hat{p}_a - \text{var}[\hat{p}_a]\,\text{var}[\hat{N}] \qquad (6)$$

where $\hat{N}$ is the estimated abundance of large chinook salmon and $\hat{p}_a$ is the estimated proportion of age *a* fish. The abundance of chinook salmon by sex in each age class $\hat{N}_{a,sex}$ was then estimated by substituting $\hat{N}_{a,sex}$, $\hat{N}_a$, and proportion of age *a* fish by sex ($\hat{p}_{a,sex}$) for $\hat{N}_a$, $\hat{N}$, and $\hat{p}_a$ in equation 5 and 6.

HARVEST

1998 Haines Marine Sport Fishery Harvest

A stratified multi-stage direct expansion creel survey was used to estimate the harvest of chinook salmon in the Haines marine boat sport fishery. Temporal stratification included 7-day (weekly) periods at one high-use site and 14-day (biweekly) periods at two low-use sites. However, a separate temporal stratum existed during the two weekends of the Haines Derby

(May 23, 24, 25, 30, and 31) at both high- and low-use sites. Each fishing day was defined as starting at 0800 hours and ending at civil twilight.

The three access locations were the Letnikof Dock (the high-use site), the Chilkat State Park boat launch, and the Small Boat harbor (Figure 1). Prior surveys indicate that anglers landing their catch at the Letnikof Dock account for 62–93% of the harvest of chinook salmon. Sampling at each location had days as primary sampling units and boat-parties as secondary units.

Sampling at Letnikof Dock occurred from May 11 to June 28, 1998, contained morning/evening stratification, and weekend/weekday stratification of evening strata during the peak of the season. Morning sampling strata lasted from 0800 hours to 2 h before midday, and evening sampling strata lasted from 2 h before midday to civil twilight. Thus, evening strata were 4 h longer in duration than morning strata. This stratification scheme was designed to maximize sampling during hours when most of the anglers exited the fishery, increasing the precision of the estimates. Random selections determined primary units to sample in each stratum. Two morning and three evening strata were sampled each week, except as noted below.

During the peak of the fishery (May 11 through June 14) evening strata at Letnikof Dock were further divided into weekday and weekend strata. Each week during this time period, two mornings, two weekday evenings, and two weekend/holiday evenings were sampled. In total, we sampled 17 unique strata at Letnikof Dock in 1998.

Sampling at the Small Boat Harbor and Chilkat State Park boat launch was initiated on May 11 and May 18, respectively, and continued through June 28. There was no type of day stratification at the low-use sites, so each sampling biweekly period was divided into 14 morning and 14 evening periods of equal length, except for the first 7 day sampling period at the Small Boat Harbor. Random selections determined primary units to sample in each morning and evening stratum. To accommodate the impossibility of sampling three sites simultaneously with only two technicians, 14 changes (period moves) were made to the randomized sampling schedule at low-use sites. Sixteen unique strata were sampled at the low-use harbors during 1998.

During each sample period, all sport fishing boats returning to the harbor were counted. Boat-parties returning to the dock were interviewed to determine: the number of rods fished; hours fished; type of trip (charter or non-charter); target species (chinook salmon, Pacific halibut *Hippoglossus stenolepis*); and number of fish kept and/or released by species. Interviewing boat-parties also included sampling all harvests of chinook salmon for maturity and missing adipose fins. Maturity was also determined (Ericksen 1994, Appendix A) in order to estimate the harvest of wild mature fish assumed to be returning to the Chilkat River. Chinook salmon were defined to be wild if: (a) they were not adipose finclipped; or (b) if they were the progeny of gametes taken from the Chilkat River drainage and were CWTd and released as fry back into their natal stream. In rare cases, some parties were not interviewed, or maturity status could not be determined. When one or more boat-parties could not be interviewed, total effort and catch for the stratum was estimated by expanding by the total number of parties returning to the dock during that period. Similarly, when a boat-party had fish of nondeterminant maturity, interview information for that boat-party was ignored, and expansions (by sample period) were made from harvests by remaining boat-parties and the total number of boat-parties counted.

The harvest in each stratum ($\hat{H}_h$) was estimated (Cochran 1977):

$$\hat{H}_h = D_h \overline{H}_h \tag{7}$$

$$\overline{H}_h = \frac{\sum_{i=1}^{d_h} \hat{H}_{hi}}{d_h} \tag{8}$$

$$\hat{H}_{hi} = M_{hi} \frac{\sum_{j=1}^{m_{hi}} h_{hij}}{m_{hi}} \tag{9}$$

where h_{hij} was the harvest on boat j in sampling days (periods) i stratum h; m_{hi} was the number

of boat parties interviewed in day i; M_{hi} was the number of boat-parties counted in day i; d_h was the number of days (morning or evening periods) sampled in stratum h; and, D_h was the number of days in stratum h. The variance of the harvest by stratum was estimated:

$$var\left[\hat{H}_h\right] = (1-f_{1h})D_h{}^2 \frac{\sum_{i=1}^{d_h}(\hat{H}_{hi}-\overline{H}_h)^2}{d_h(d_h\text{-}1)} + D_h\sum_{i=1}^{d_h} M_{hi}{}^2(1-f_{2hi})\frac{\sum_{j=1}^{m_{hi}}(h_{hij}\text{-}\overline{h}_{hi})^2}{d_h m_{hi}(m_{hi}\text{-}1)} \quad (10)$$

where f_{1h} was the sampling fraction for periods and f_{2hi} was the sampling fraction for boat-parties. Catch and effort was estimated similarly, substituting C and E for H in equation 7 through equation 10. Total harvests for the season were the sums across strata ΣH_h and $\Sigma \text{var}[H_h]$. Similarly, the effort and harvest by charter boat anglers were estimated by considering only data collected from chartered anglers in equation 7 through 10.

Chinook salmon sampled in the angler harvest were measured to the nearest 5 mm fork length. Five scales were removed from the left side of each sampled fish (right side if left side scales were regenerated), along a line two scale rows above the lateral line between the posterior insertion of the dorsal fin and anterior insertion of the anal fin. A triacetate impression of the scales (30 s at 3,500 lb/in² at a temperature of 97°C) was used for age determination. Scales were aged using procedures in Olsen (1992). Information recorded for each chinook salmon sampled included sex, length, maturity, and presence or absence of adipose fins.

Age composition and mean length-at-age of chinook salmon in the sport fishery harvest, and associated variances were estimated using standard normal statistics. This calculation for a stratified sampling program is warranted when there is no trend in the age composition or sampling is proportional over time. Because sampling was not proportional in all strata, a chi-square statistic was used to test whether there was a change in the age composition over time.

Technicians retained heads from chinook salmon missing adipose fins, and a locking plastic strap with a unique number was inserted through the jaw of the head. Heads and CWT recovery data were sent to the ADF&G CWT Processing Laboratory in Juneau, where any tags present were removed, decoded, and corresponding information entered into the tag lab database.

Contribution of Coded Wire Tagged Stocks

Chinook salmon eggs were collected from the Tahini River and Big Boulder Creek in 1991 and incubated in a hatchery. The resulting fry were fed for a short period, had their adipose fins removed, injected with a half length CWT, and were released into their stream of origin the following spring (Table 1). The tagged fry remained in the drainage for about one year, and emigrated to sea the following spring. These fish were harvested in sport and commercial fisheries sampled by ADF&G port sampling programs. The contribution of the 1991 brood to sampled fisheries, and the contribution of all tagged stocks to the 1998 Haines marine boat sport fishery were estimated:

$$\hat{r}_{ij} = \hat{H}_i\left(\frac{m_{ij}}{\lambda_i n_i}\right)\hat{\theta}_j{}^{-1} \quad (11)$$

where $\hat{H}_i$ is the estimated harvest of stock j in stratum i, $\hat{\theta}_i$ is the fraction of stock j marked with CWTs, n_i is the subset of $\hat{H}_i$ examined for missing adipose fins, m_{ij} is the number of decoded CWTs recovered from stock j, and $\lambda_i = (a_i't_i')/(a_i t_i)$ is the decoding rate for CWTs from recovered salmon. See Bernard and Clark 1996 for further details. Statistics from the commercial troll fishery were stratified by fishing period and fishing quadrant. Statistics from drift gillnet and purse seine fisheries were stratified by week and fishing district. Statistics from recreational fisheries were stratified by biweek.

Variance of $\hat{r}_{ij}$ was estimated using the appropriate large-sample formulations in Bernard and Clark

Table 1.–Releases of 1990, 1991, and 1992 brood year coded wire tagged chinook salmon into the Chilkat River drainage by tag code, and release site, 1991–1993.

Tag code	Facility	Brood year	Release site/stock	Date released	Total marked	Tags shed	Number of valid CWTs
401010913	Jerry Myers	1990	Tahini R.	05/24/91	11,368	796	10,572
401011014	Jerry Myers	1990	Tahini R.	05/24/91	24,948	0	24,948
		1990 BROOD YEAR TOTAL			**36,316**	**796**	**35,520**
401010911	Gastineau/DIPAC	1991	Big Boulder Cr.	05/22/92	12,121	206	11,915
401020510	Gastineau/DIPAC	1991	Big Boulder Cr.	05/22/92	10,885	577	10,308
401020601	Gastineau/DIPAC	1991	Big Boulder Cr.	05/22/92	21,814	687	20,795
401020602	Gastineau/DIPAC	1991	Tahini R.	05/20/92	34,418	1,067	33,351
401020603	Gastineau/DIPAC	1991	Tahini R.	05/20/92	28,161	957	27,204
		1991 BROOD YEAR TOTAL			**107,399**	**3,494**	**103,573**
401020911	Gastineau/DIPAC	1992	Big Boulder Cr.	05/28/93	23,389	1,614	21,775
		1992 BROOD YEAR TOTAL			**23,389**	**1,614**	**21,775**

(1996, their Table 2) for wild or hatchery stocks harvested in commercial or recreational fisheries. The total contribution of one or more cohorts to one or more fisheries is the sum of harvests and variances from the individual cohorts and strata.

An estimate of $\hat{\theta}$ for the 1991 brood year was computed from adults sampled in gillnets and fish wheels on the lower Chilkat River. Because this sampling was spread over time, the binomial probability distribution was considered an adequate model for the recovery of tagged fish, and the statistic $V[\hat{\theta}^{-1}]$ was estimated by Monte Carlo simulation (Geiger 1990, Bernard and Clark 1996, Bernard et al. 1998).

The subsistence harvest of 1991 brood year Chilkat River chinook salmon (H_b) in a given year was estimated:

$$\hat{H}_b = H_T \hat{p}_b \qquad (12)$$

$$\text{var}[\hat{H}_b] = H_T^2 \frac{p_b(1-p_b)}{(n-1)} \qquad (13)$$

where H_T is the total subsistence harvest of chinook salmon on the Chilkat River reported to ADF&G, and p_b is the proportion of fish caught in fish wheels and drift gillnets on the lower Chilkat River that belong to the 1991 brood year.

RESULTS

INRIVER ABUNDANCE

We captured 231 large (age 1.3 and older), 28 medium (age 1.2), and 51 small chinook salmon in the lower Chilkat River with drift gillnets and fish wheels between June 11 and August 4, 1998 (Table 2, Figure 3). Of the 231 large fish captured, 227 were given an external spaghetti tag. One large (≥age 1.3) fish captured in the fish wheels was found dead and three large fish escaped prior to being marked. Capture rates of large chinook salmon peaked on June 24. The mean date of migratory timing (weighted mean, Mundy 1984) in the lower river was June 25 (Figure 4). Fish captured in the gillnet were predominantly age 1.4 (61.3%) and classified as female (62.2%, Table 3). Those captured in fish wheels were classified as mostly males (76.6%), and most commonly age 1.1 (38.4%, Table 3). Large chinook salmon captured in gillnets

Table 2–Numbers of chinook salmon caught in the lower Chilkat River by time period, gear type and size, June 8 through August 6, 1998.

Time period	Drift gillnet			Fish wheels			Combined			
	Large	Medium	Small	Large	Medium	Small	Large	Medium	Small	Total
6/08-6/12	1	0	0	2	0	0	3	0	0	3
6/13-6/17	34	1	0	11	0	0	45	1	0	46
6/18-6/22	23	1	0	2	1	3	25	2	3	30
6/23-6/27	45	2	0	16	10	11	61	12	11	84
6/28-7/02	17	0	0	12	8	11	29	8	11	48
7/03-7/07	23	0	0	6	2	13	29	2	13	44
7/08-7/12	16	0	2	5	3	9	21	3	11	35
7/13-7/17	7	0	0	4	0	2	11	0	2	13
7/18-7/22				6	0	0	6	0	0	6
7/23-7/27				0	0	0	0	0	0	0
7/28-8/01				0	0	0	0	0	0	0
8/02-8/06				1	0	0	1	0	0	1
Total	166	4	2	65	24	49	231	28	51	310

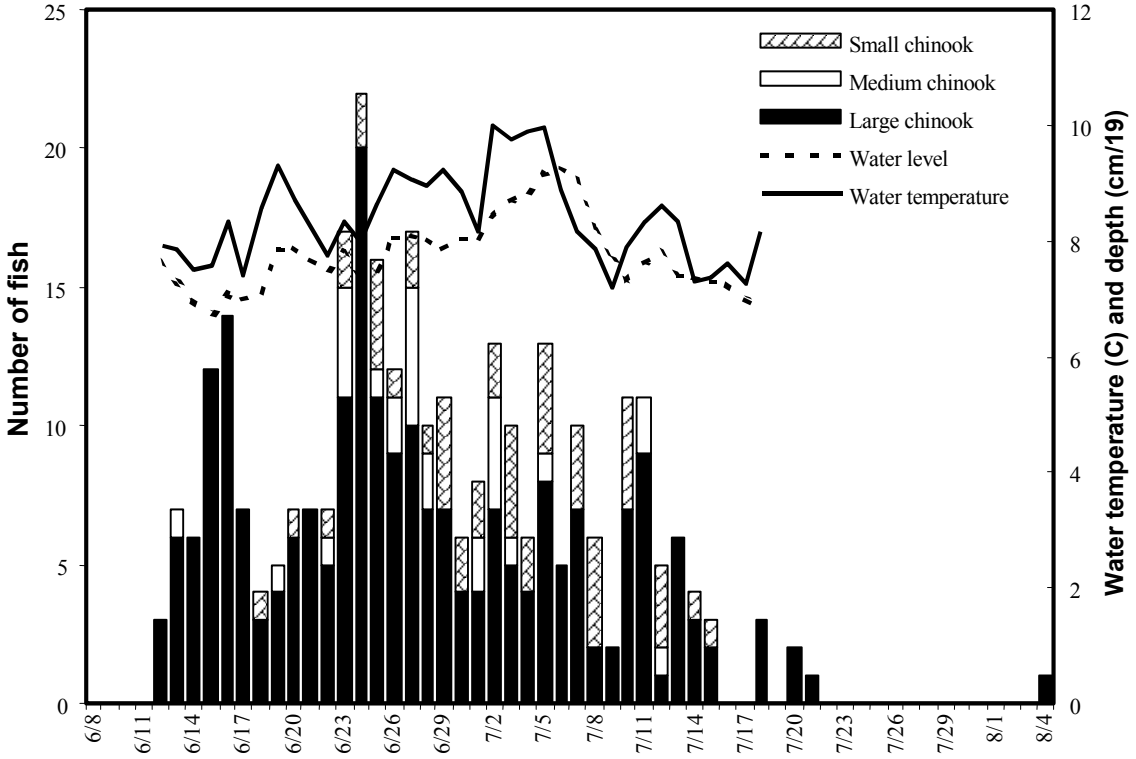

Figure 3.–Daily water depth (cm/19), temperature (°C), and catches of small (<age 1.2), medium (age 1.2), and large (≥age 1.3) chinook salmon in drift gillnets and fish wheels operating in the lower Chilkat River, June 8 through August 4, 1998.

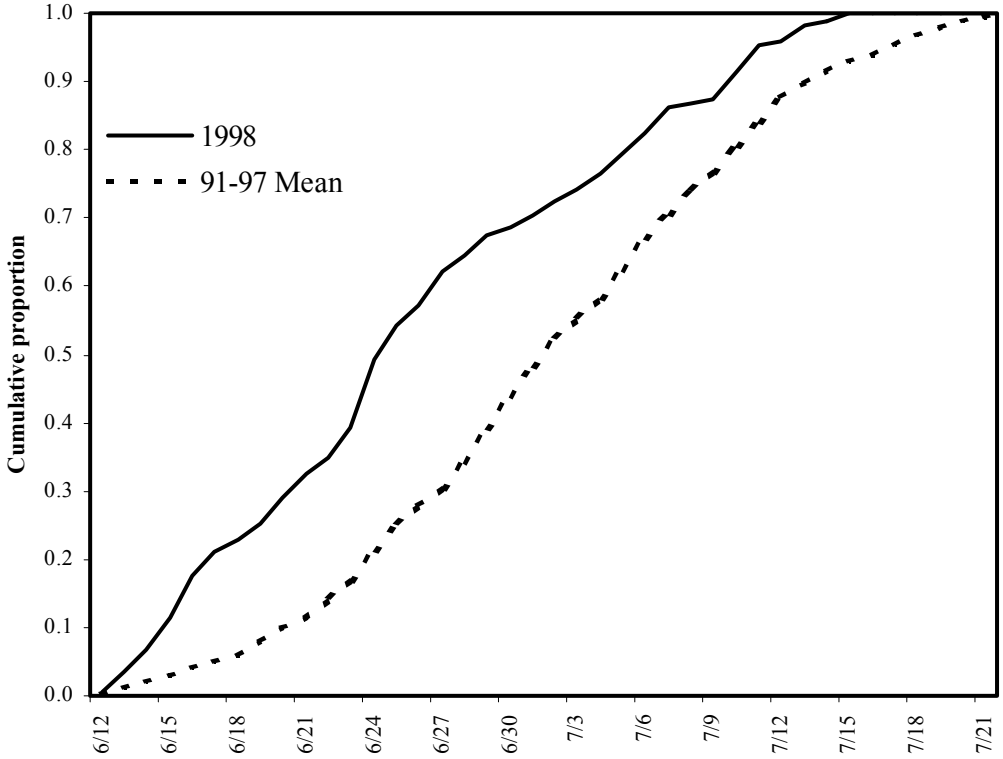

Figure 4.–Cumulative proportion of large (≥age 1.3) chinook salmon captured with drift gillnets in the lower Chilkat River in 1998 compared to mean cumulative proportion, 1991–1997.

and fish wheels were not significantly different in size (K-S test, $d_{max} = 0.126$, P = 0.467).

We examined 531 large, 39 medium, and 30 small chinook salmon on the spawning grounds for marks (Table 4). Thirty-two (32) large, 2 medium, and no small marked fish were recovered (Table 4). Four large and one medium marked fish were recovered with missing tags but were identified as marked fish by the opercular punch. Also, one tag from a large fish recovered was so badly damaged that the tag number could not be read. The probability of capturing a marked chinook salmon on the three spawning tributaries was not significantly different ($\chi^2 = 0.939$, df = 2, P = 0.625); thus data from all spawning areas were combined to estimate abundance.

The cumulative distribution function (CDF) of lengths of large chinook salmon marked in the lower Chilkat River was not significantly different from the CDF of large tagged chinook salmon recaptured on the spawning grounds (K-S test, $d_{max} = 0.010$, P = 0.942, Figure 5, top). This result suggests the second sampling event was not size-selective for large fish. Thus, an estimated 3,675 (SE = 565) large chinook salmon immigrated into the Chilkat River in 1998 under the Petersen model ($n_1 = 227$, $n_2 = 531$, $m_2 = 32$). This estimate is germane to time of tagging in the lower river, since an unquantified removal occurs (due to natural mortality and subsistence fishery harvest) between the two sampling events.

Age and Sex Composition of the Escapement

We sampled 586 chinook salmon on the spawning grounds for age and sex. Of those

Table 3.–Age composition of chinook salmon sampled during tagging activities on the Chilkat River, by gear type, 1998.

		BROOD YEAR AND AGE CLASS						
		1995 1.1	1994 1.2	1993 1.3	1992 1.4	1991 1.5	**Total aged**	**Total sampled[a]**
Males		**GILLNET, MILE 7.5**						
	Sample size	1	3	20	30	2	56	65
	Percent	1.8	5.4	35.7	53.6	3.6		37.8
	SD	1.8	3.0	6.4	6.7	2.5		3.7
	Mean length	445	632	723	925	1015		
	SD		26.6	92.1	66.6	35.0		
Females								
	Sample size	0	0	27	62	5	94	107
	Percent			28.7	66.0	5.3		62.2
	SD			4.7	4.9	2.3		3.7
	Mean length			795	871	907		
	SD			47.6	40.9	27.9		
All fish								
	Sample size	1	3	47	92	7	150	172
	Percent	0.7	2.0	31.3	61.3	4.7		
	SD	0.7	1.1	3.8	4.0	1.7		
	Mean length	445	632	764	888	938		
	SD		26.6	78.7	56.7	57.3		
Males		**FISHWHEELS, 8 AND 9 MILE**						
	Sample size	41	13	14	14	1	83	105
	Percent	49.4	15.7	16.9	16.9	1.2		76.6
	SD	5.5	4.0	4.1	4.1	1.2		3.6
	Mean length	385	534	762	902	830		
	SD	41.6	60.9	70.4	59.0			
Females								
	Sample size	2	2	6	13	6	29	32
	Percent	6.9	6.9	20.7	44.8	20.7		23.4
	SD	4.7	4.7	7.5	9.2	7.5		3.6
	Mean length	448	575	768	875	890		
	SD	22.5	45.0	38.9	79.2	42.4		
All fish								
	Sample size	43	15	20	27	7	112	137
	Percent	38.4	13.4	17.9	24.1	6.3		
	SD	4.6	3.2	3.6	4.0	2.3		
	Mean length	388	539	764	889	881		
	SD	43.0	60.6	62.7	70.7	44.5		

[a] Includes fish that were not assigned an age.

Table 4.–Number of chinook salmon inspected for marks and number of marked fish recaptured during tag recovery surveys in the Chilkat River drainage, by location, size, and sex, 1998.

		INSPECTED [a]											MARKED						
		Large				Medium				Small			Large			Medium			Small
	Dates	M	F	U	Total	M	F	U	Total	M	F	Total	M	F	Total	M	F	Total	Total
Kelsall	8/02-9/05	193	174	16	383	18	1	1	20	20	0	20	12	9	21	1	0	1	0
Nataga	8/06-8/27	1	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tahini	8/03-9/01	58	54	0	112	11	0	0	11	3	0	3	2	6	8	1	0	1	0
Big Boulder	8/06-9/02	21	13	0	34	8	0	0	8	7	0	7	2	1	3	0	0	0	0
Total		273	242	16	531	37	1	1	39	30	0	30	16	16	32	2	0	2	0

[a] M = male, F = female, U = not sexed.

sampled, 512 were successfully aged (Table 5). The CDF of lengths of marked fish was not significantly different from the CDF of large chinook salmon examined for marks on the spawning grounds (K-S test, $d_{max} = 0.042$, P = 0.940; Figure 5, bottom). Neither were age compositions of large fish significantly different between gillnet and fish wheel ($\chi^2 = 3.986$, df = 2, P = 0.136) or among spawning tributaries—excluding Big Boulder Creek ($\chi^2 = 0.799$, df = 2, P = 0.671). The age composition of the Big Boulder Creek samples was significantly different from other spawning ground samples, so these samples were not used to estimate age or sex composition. The age composition of large fish was not significantly different between the marking and recovery events ($\chi^2 = 5.989$, df = 2, P = 0.0501). In conjunction with results showing no size selectivity, these results suggest neither sampling event was size (or age) selective for large fish, and that both sampling events should be used to estimate age composition of the escapement. Sex composition of large chinook salmon, however, was significantly different between marking and recovery events ($\chi^2 = 30.370$, df = 1, P < 0.001). The sex composition of large fish sampled differed significantly between gillnet and fish wheels ($\chi^2 = 4.723$, df = 1, P = 0.030), but not between the Tahini and Kelsall River spawning grounds ($\chi^2 = 1.080$, df = 1, P = 0.299). Therefore, because sex determination is known to be more difficult early in the season during the marking event (Ericksen 1995, 1996, 1997, 1998), only the Tahini and Kelsall River spawning ground samples were used to estimate sex composition by age in the escapement.

Sixty-six percent (66%) of the estimated escapement of large chinook were age 1.4 fish (1992 brood year, Table 6). The second largest age class was age 1.3 fish (28%).

HARVEST

1998 Haines Marine Sport Fishery Harvest

An estimated total of 8,200 (SE = 747) angler-hours of effort were expended in the Haines marine boat fishery between May 11 and June 28, 1998 to catch 222 (SE = 60), and harvest 215 (SE = 56) large chinook salmon (Table 7). This was based on a sample of 309 boat-parties who fished 3,065 angler-hours (2,916 salmon-hours), and harvested 93 large (28 inches or greater total length) chinook salmon (Table 7). An estimated 153 (SE = 51) of the chinook salmon harvested in this fishery were wild mature fish assumed to be returning to the Chilkat River. About 92% (7,546 salmon-hours, SE = 747) of angler effort targeted chinook salmon, and the remainder was directed toward other species, primarily Pacific halibut. Anglers caught an estimated 92 (SE = 21) small (sublegal, <28 inches total length) chinook salmon of which 35 (SE = 23) were kept. Seventy-nine percent (79%) of the estimated salmon effort and 83% of the estimated harvest of chinook salmon occurred between May 18 and June 14 (Table 7).

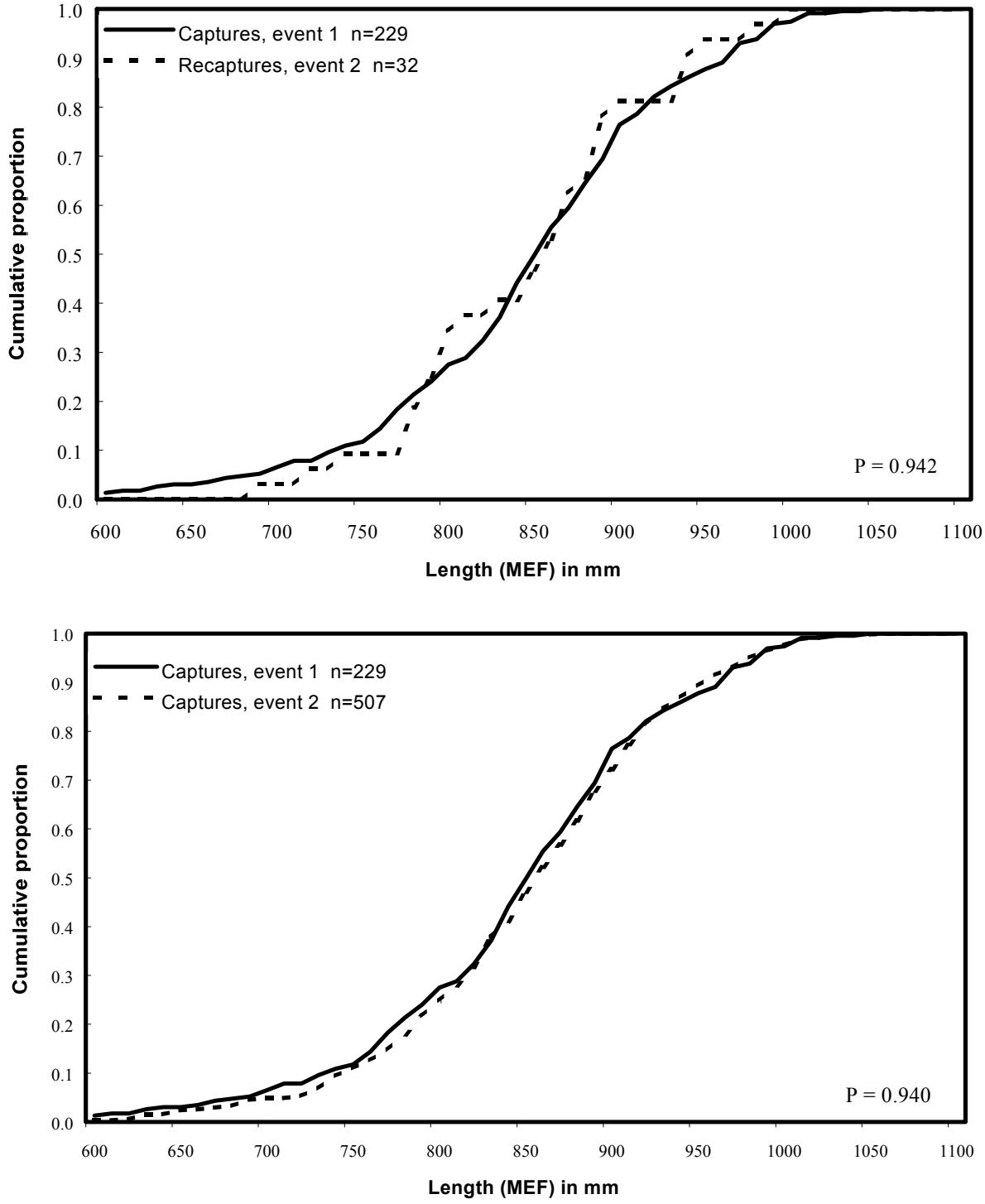

Figure 5.–Cumulative distribution function (CDF) of MEF lengths of large (≥age 1.3) chinook salmon marked in the lower Chilkat River versus lengths of marked fish recaptured on the spawning grounds (top) and versus lengths of large fish examined for marks on the spawning grounds (bottom), 1998.

Table 5.–Age composition of chinook salmon sampled during recovery surveys on the Chilkat River drainage, by spawning tributary, 1998.

		BROOD YEAR AND AGE CLASS							
		1995 1.1	1994 1.2	1993 1.3	1992 1.4	1991 1.5	1991 2.4	**Total aged**	**Total sampled** [a]
TAHINI RIVER									
Males	Sample size	2	11	21	30	3	0	67	72
	Percent	3.0	16.4	31.3	44.8	4.5			57.1
	SD	2.1	4.5	5.7	6.1	2.5			4.4
	Mean length	375	541	743	889	970			
	SD	21.2	59.5	77.5	71.2	30.0			
Females	Sample size	0	0	3	41	4	0	48	54
	Percent			6.3	85.4	8.3			42.9
	SD			3.5	5.1	4.0			4.4
	Mean length			822	869	929			
	SD			55.8	46.5	69.8			
All fish	Sample size	2	11	24	71	7	0	115	126
	Percent	1.7	9.6	20.9	61.7	6.1			
	SD	1.2	2.7	3.8	4.5	2.2			
	Mean length	375	541	753	877	946			
	SD	21.2	59.5	78.7	58.5	56.8			
BIG BOULDER CREEK									
Males	Sample size	6	7	17	2	0	0	32	36
	Percent	18.8	21.9	53.1	6.3				73.5
	SD	6.9	7.3	8.8	4.3				6.3
	Mean length	363	587	757	898				
	SD	49.8	84.1	54.8	17.7				
Females	Sample size	0	0	3	7	2	0	12	13
	Percent			25.0	58.3	16.7			26.5
	SD			12.5	14.2	10.8			6.3
	Mean length			803	837	880			
	SD			23.1	40.0	42.4			
All fish	Sample size	6	7	20	9	2	0	44	49
	Percent	13.6	15.9	45.5	20.5	4.5			
	SD	5.2	5.5	7.5	6.1	3.1			
	Mean length	363	587	764	851	880			
	SD	49.8	84.1	53.6	44.1	42.4			
KELSALL RIVER/NATAGA									
Males	Sample size	15	14	54	110	6	1	200	232
	Percent	7.5	7.0	27.0	55.0	3.0	0.5		56.9
	SD	1.9	1.8	3.1	3.5	1.2	0.5		2.5
	Mean length	395	534	770	912	988	820		
	SD	46.9	62.0	74.6	70.1	65.0			
Females	Sample size	0	1	27	113	9	0	150	176
	Percent		0.7	18.0	75.3	6.0			43.1
	SD		0.7	3.1	3.5	1.9			2.5
	Mean length		650	796	863	861			
	SD			41.0	51.0	27.1			
All fish	Sample size	15	15	81	223	15	1	350	408
	Percent	4.3	4.3	23.1	63.7	4.3	0.3		
	SD	1.1	1.1	2.3	2.6	1.1	0.3		
	Mean length	395	542	779	887	912	820		
	SD	46.9	66.8	66.2	65.8	78.1			

[a] Includes fish that were not assigned an age. Not all fish examined for marks were scale sampled (i.e., carcass decayed, part of body missing, etc.).

Table 6.–Estimated abundance of chinook salmon in the 1998 Chilkat River escapement, by age and sex.

	BROOD YEAR AND AGE CLASS				
	1993 1.3	1992 1.4	1991 1.5	1991 2.4	**Total**
Male	726	1,162	87	6	1,981
SE	129	195	29	6	235
Female	290	1,278	126		1,694
SE	66	212	36		225
All fish	1,016	2,440	213	6	3,675
SE	169	381	47	6	565

Angling pressure for chinook salmon was relatively light during the first and last week, so our coverage of the fishery for mature chinook salmon was essentially complete.

Estimates by site are presented in Appendices A1 through A3. Charter boat anglers accounted for about 39% of the salmon effort (1,206 salmon-hours, SE = 155), and 17% of the harvest (37, SE = 21) of chinook salmon in this fishery.

Anglers returning to the Letnikof Dock (the high-use site) were responsible for 72% of the estimated salmon effort (5,399 salmon-hours, SE = 532) and 59% of the estimated harvest (126, SE = 34) of large chinook salmon (Appendix A1). Anglers returning to the Chilkat State Park boat launch and the Small Boat Harbor accounted for an estimated 825 (SE = 341) and 1,322 (SE = 400) salmon-hours of effort, respectively, and took respective harvests of 49 (SE = 35) and 40 (SE = 27) large chinook salmon (Appendices A2 and A3).

Table 7.–Sampling statistics and total estimated effort, catch, and harvest of chinook salmon in the Haines marine boat sport fishery, by biweek, May 11 through June 28, 1998.

		May 18–May 31				
	May 11–May 17	**Non-derby**	**Derby**	**June 1–June 14**	**June 15–June 28**	**Total**
Boats counted	32	28	75	127	47	309
Angler-hs. sampled	219	261	1,006	1,164	415	3,065
Salmon-hs. sampled	209	235	994	1,134	344	2,916
Chinook sampled	4	2	39	37	11	93
Sampled for ad-clips	4	2	39	37	11	93
Ad-clips	0	0	1	1	2	4
Angler-hours						
Estimate	364	912	2,622	2,674	1,628	8,200
Variance	13,713	155,225	145,641	200,159	143,393	658,131
Salmon-hours						
Estimate	333	828	2,592	2,527	1,266	7,546
Variance	9,544	133,970	155,136	198,941	61,098	558,689
Large chinook catch						
Estimate	9	6	46	132	29	222
Variance	34	6	28	3,267	231	3,566
Large chinook kept						
Estimate	9	6	46	125	29	215
Variance	34	6	28	2,805	231	3,104
Wild mature chinook kept (excluding hatchery and immature fish)						
Estimate	4	3	5	112	29	153
Variance	4	6	8	2,327	231	2,576
Small chinook catch						
Estimate	0	8	13	8	63	92
Variance	0	22	34	0	378	434
Small chinook kept						
Estimate	0	0	0	0	35	35
Variance	0	0	0	0	546	546

Age and Length of Harvest

We sampled a total of 92 chinook salmon for age and length in the angler harvest; 77 of these were assigned an age. The age composition of the harvest during May was not significantly different from that during June (χ^2 = 0.524, df = 1, P = 0.469) so samples were pooled over time. Fish landed at the Small Boat Harbor were more likely to be from hatchery releases in Taiya Inlet (Figure 1), so these samples were analyzed separately.

We sampled 81 chinook salmon for age and length at the Chilkat Inlet harbors (Letnikof Dock and Chilkat State Park boat launch), and 70 of these were assigned an age (Table 8). Most (63.0%, SE = 5.4%) of the chinook harvested were male. The predominant age class was age 1.4 (63.0%, SE = 5.4%).

We sampled 11 chinook salmon for age and length at the Small Boat Harbor and 7 of these were assigned an age (Table 8). Five of those sampled were less than 28 inches in total length (caught in the Taiya Inlet terminal harvest area for hatchery chinook salmon).

Contribution of Coded Wire Tagged Stocks

Hatchery-reared chinook salmon released into the Chilkat River drainage (1992 brood), fish with CWTs from Taiya Inlet/Burro Creek releases (1992 and 1994 broods), and fish released in Auke Bay, near Juneau (1994 brood) were recovered in the 1998 Haines marine creel survey (Table 9). Four (4) of the 93 chinook salmon sampled between May 11 and June 28, were missing their adipose fins. Fish landed at the Small Boat Harbor were more likely to be from hatchery releases in Taiya Inlet so these samples were analyzed separately. However, one adipose fin clipped chinook salmon landed at the Small Boat Harbor was entered into the Haines Salmon Derby. Samples were pooled during this biweek (May 18 through May 31) over all harbors because derby fish were sampled at the derby weigh-in station located at the Letnikof Dock regardless of where they were landed. Four (SE = 3) of the estimated 215 large chinook salmon and 14 (SE = 9) of the estimated 35 small chinook salmon harvested in the Haines marine boat sport fishery were of hatchery origin. Three (3) of these (SE = 3) were from fry releases into Big Boulder Creek of the Chilkat River (Table 9).

1991 Brood Year Contribution to Common Property Fisheries

We sampled 693 adult chinook salmon from brood year 1991 in gillnets and fish wheels operating in the lower Chilkat River between 1994 and 1998 (Table 10). Thirty-three (33) were missing adipose fins, resulting in an estimated tagging fraction (θ) of 0.0477 (SE = 0.00811).

Ninety-nine (99) chinook salmon (brood years 1990, 1991, and 1992) with CWTs released into the Chilkat River were recovered (random, select, and volunteer) between 1994 and 1998 (Appendix A4). Eighty-four (84) of these were from the 1991 brood year. Twenty-nine (29) 1991 brood year chinook salmon were randomly recovered in various Alaska fisheries (Table 11). All of these fish were recovered in the inside waters of Southeast Alaska, with the exception of one recovery in southcentral Alaska near Anchor Point (Figure 6). These recoveries were used to estimate a harvest of 1,055 (SE = 215) brood year 1991 Chilkat River fish in the randomly sampled Alaska sport and commercial fisheries (Table 12). In addition, 146 chinook salmon were reported in the Chilkat Inlet and Chilkat River subsistence fisheries between 1995 and 1998. An estimated 84 (SE = 2) of these were from the 1991 brood year (Table 13). Thus, the total estimated harvest of 1991 brood year Chilkat River chinook salmon was 1,139 (SE = 215).

The harvest was relatively evenly distributed between the recreational (32.8%), commercial drift gillnet (26.4%), and commercial troll (24.1%) fisheries (Table 13). Smaller harvests were estimated for the subsistence (7.4%) and commercial seine (9.3%) fisheries.

Age 1.3 fish composed the highest percent of the estimated harvest of 1991 brood year Chilkat River chinook salmon (Table 14). All of the estimated age 1.1 harvest was taken in the seine fishery. Most (64.5%) of the age 1.2 estimated

Table 8.–Estimated age composition and mean length-at-age (measured in mm from snout to fork of tail) of harvested chinook salmon in the Haines marine boat sport fishery, by location, May 11 through June 28, 1998.

		BROOD YEAR AND AGE CLASS						
		1994 1.2	1993 1.3	1992 1.4	1991 1.5	1991 2.4	Total aged	Total sampled [a]
CHILKAT INLET HARBORS								
Males	Sample size	1	9	28	3	0	41	51
	Percent	2.0	17.6	54.9	5.9			63.0
	SE	1.9	5.3	7.0	3.3			5.4
	Mean length	730	799	1,016	1,037			
	SE		84	69	12			
Females	Sample size	0	2	23	3	1	29	30
	Percent		6.7	76.7	10.0	3.3		37.0
	SE		4.6	7.7	5.5	3.3		5.4
	Mean length		880	978	1,033	1,040		
	SE		42	56	51			
Combined	Sample size	1	11	51	6	1	70	81
	Percent	1.2	13.6	63.0	7.4	1.2		
	SE	1.2	3.8	5.4	2.9	1.2		
	Mean length	730	814	999	1,035	1,040		
	SE		83	65	33			
SMALL BOAT HARBOR								
Males	Sample size	1	2	0	0	0	3	5
	Percent	33.3	66.7					45.5
	SE	27.2	27.2					15.0
	Mean length	715	790					
	SE		141					
Females	Sample size	3	1	0	0	0	4	6
	Percent	75.0	25.0					54.5
	SE	21.7	21.7					15.0
	Mean length	627	790					
	SE	28.9						
Combined	Sample size	4	3	0	0	0	7	11
	Percent	57.1	42.9					
	SE	18.7	18.7					
	Mean length	649	790					
	SE	50	100					

[a] Includes fish that were not assigned an age.

Table 9.–Contribution estimates of coded wire tagged chinook salmon to the Haines marine sport fishery, with statistics used for computing estimates by biweek, 1998. Because the Haines king salmon derby occurred May 23, 24, 25, 30 and 31, and fish sampled at the derby weigh-in station could have been landed at the Small Boat Harbor, samples for the May 18–May 31 biweek were combined.

Hatchery	Release site	Tag code	Brood year	Biweek	Harvest H	Harvest SE	Sample *n*	Adclips *a*	Head *a′*	Detect *t*	Decode *t′*	Tags *m*	Contribution *r*	Contribution SE
CHILKAT INLET RECOVERIES														
Hidden Falls	Taiya Inlet	04-41-29	1992	May 18–May 31	52	6	41	1	1	1	1	1	1	1
Gastineau	Big Boulder	04-01-020911	1992	June 1–June 14	97	51	32	1	1	1	1	1	3	3
				Subtotal									4	3
SMALL BOAT HARBOR RECOVERIES (expansions based on small (< 28") chinook salmon)														
Burro Creek	Burro Creek	04-46-22	1994	June 15–June 28	35	23	5	2	2	2	2	1	7	7
Gastineau	Auke Bay	04-37-37	1994	June 15–June 28	35	23	5	2	2	2	2	1	7	7
				Subtotal									14	9
Total													**18**	**10**

Table 10.–Number of 1990, 1991, and 1992 brood year chinook salmon sampled for adipose finclips in the lower Chilkat River by year and gear type, and estimates of the marked fraction, θ, 1994–1998.

		Brood year 1990[a]					Brood year 1991					Brood year 1992[a]				
Year	Gear	Examined	Adclips	θ_{yr}	θ^b (SE)	$1/\theta$ (var)	Examined	Adclips	θ_{yr}	θ^b (SE)	$1/\theta$ (var)	Examined	Adclips	θ_{yr}	θ^b (SE)	$1/\theta$ (var)
1994	Gillnet	1	0													
	Fish wheels	14	1	0.067			144	3	0.021							
1995	Gillnet	14	1				35	0								
	Fish wheels	9	0	0.043			48	3	0.036			41	0	na		
1996	Gillnet	31	0				163	13				5	0			
	Fish wheels	5	0	na			45	3	0.077			11	0	na		
1997	Gillnet						144	9				45	1			
	Fish wheels						97	2	0.045			31	0	0.013		
1998	Gillnet						8	0				105	0			
	Fish wheels						8	0	na			33	0			
	Total	74	2		0.027 (0.019)	37 (675)	692	33		0.0477 (0.0081)	20.97 (14.72)	271	1		0.00369 (0.00369)	271.00 (73,441)

[a] Low sampling rates for the 1990 and 1992 brood years prevent an accurate fishery contribution estimate for these broods.

[b] Best estimate to date.

Table 11.–Number of random recoveries of 1991 brood year Chilkat River coded wire tagged chinook salmon reported by fishing district and gear type, 1994 through 1998.

District	Escapement	Gillnet	Seine	Sport	Subsistence	Troll	Total	Percent
111	0	1	0	1	0	0	2	2.5
112	0	0	4	0	0	5	9	11.3
114	0	0	1	0	0	1	2	2.5
115	51	5	0	8	1	0	65	81.3
244	0	0	0	1	0	0	1	1.3
Unknown	0	0	0	0	0	1	1	1.3
Total	51	6	5	10	1	7	80	

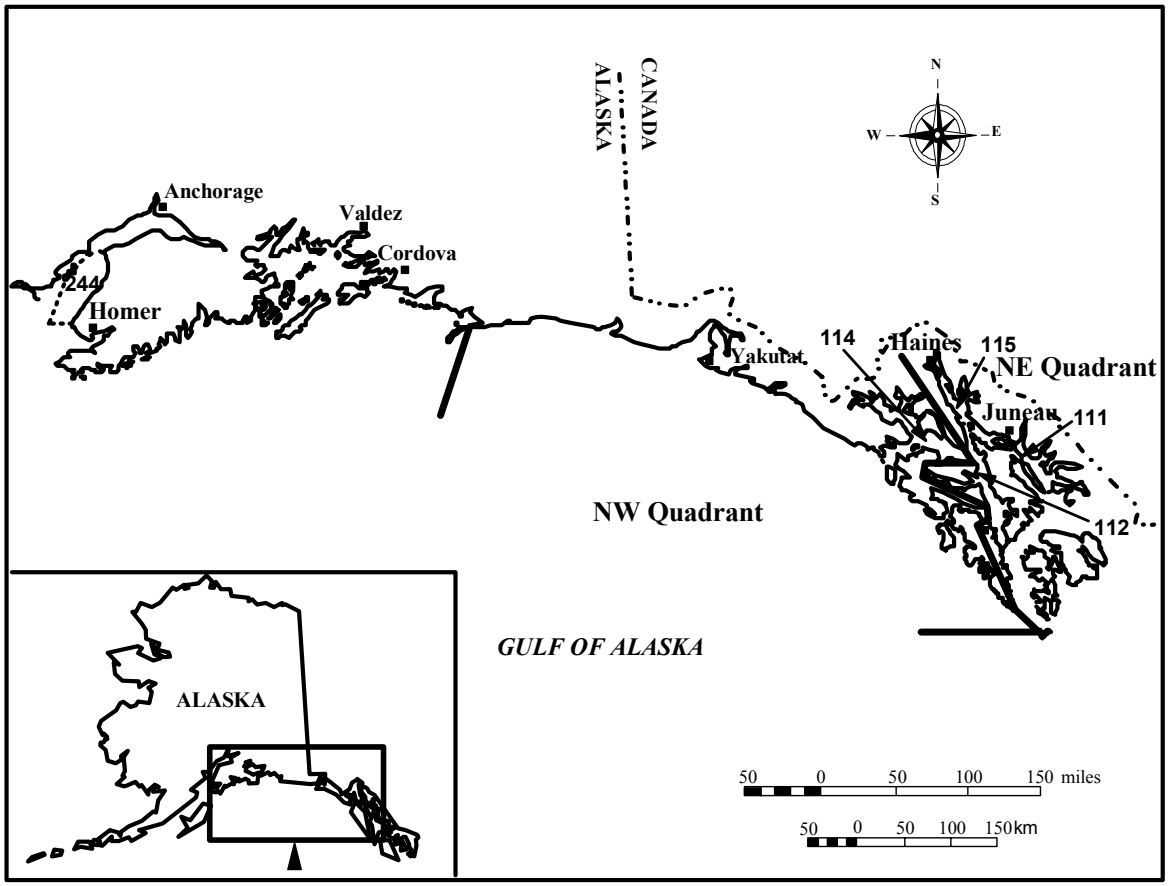

Figure 6.–Commercial fishing districts along the coast of Alaska where coded wire tagged 1991 brood year Chilkat River chinook salmon were recovered.

Table 12.–Sport and commercial and fishery contributions of 1991 brood year Chilkat River chinook salmon by recovery year, fishery, and time period, 1994–1997.

Fishery	Stat. week	Biweek	Troll period	District	Harvest N	Harvest SE[N]	Sample *n*	Adclip *a*	Heads *a′*	Detect *t*	Decode *t′*	Tags *m*	Contribution *r*	Contribution SE
1994 RECOVERIES: AGE 1.1														
Chatham seine	28			112	308		308	28	28	24	24	1	21	20
Chatham seine	31			112	46		46	7	7	6	6	1	21	20
Chatham seine	34			112	219		219	22	21	20	20	1	22	21
Chatham seine	35			112	33		33	4	4	4	4	1	21	20
Homeshore seine	32			114	242		242	29	29	25	25	1	21	20
1995 RECOVERIES: AGE 1.2														
Lynn Canal gillnet	25			115	321		93	15	15	14	14	1	72	72
Lynn Canal gillnet	26			115	93		52	7	7	5	5	1	38	37
Lynn Canal gillnet	28			115	41		11	3	3	2	2	1	78	78
Haines sport	24			115	120	31	49	6	6	6	6	1	51	51
NE quad troll	45		6		8,021		4,296	484	482	432	432	1	39	39
1996 RECOVERIES: AGE 1.3														
Taku gillnet	26			111	1,058		419	17	17	15	15	1	53	52
Lynn Canal gillnet	32			115	20		14	4	4	4	4	2	60	42
Haines sport	22,23			115	99	8	79	12	12	11	11	2	53	37
Haines sport	25			115	37	13	19	1	1	1	1	1	41	40
Juneau sport	33	17		111	653		653	83	80	74	74	1	22	21
NE quad troll	22		2	112	28,320		18,278	1,401	1,383	1,243	1,243	4	132	68
NW quad troll	27		3	114	5,316		1,763	165	162	151	151	1	64	64
1997 RECOVERIES: AGE 1.4														
Haines sport	22,23			115	194	15	138	15	14	10	10	3	95	56
Haines sport	25			115	31	10	11	1	1	1	1	1	59	59
Anchor Pt. Sport	23			244	6,120	359	2,414	54	54	50	50	1	53	53
NE quad troll	25		2	112	14,712		7,901	980	970	896	896	1	39	39
TOTAL BROOD YEAR 1991					66,004		37,038					28	1,055	215

Table 13.–Estimated harvest of 1991 brood year Chilkat River chinook salmon by fishery, age class, and year harvested.

Fishery	Age	Year of harvest	Estimated harvest	SE	%
SUBSISTENCE FISHERIES					
Chilkat Inlet	1.2	1995	8	1.4	
	1.3	1996	35	1.3	
	1.4	1997	14	0.6	
	1.5	1998	1	0.3	
	Subtotal		58	2.0	5.1
Chilkat River	1.2	1995	4	0.7	
	1.3	1996	14	0.5	
	1.4	1997	7	0.3	
	1.5	1998	0	0.0	
	Subtotal		25	0.9	2.2
	Subsistence total		**84**	**2.2**	**7.4**
RECREATIONAL FISHERIES					
Haines sport	1.2	1995	51	51	
	1.3	1996	93	55	
	1.4	1997	154	81	
	Subtotal		299	110	26.2
Juneau sport	1.3	1996	22	21	
	Subtotal		22	21	1.9
Anchor sport	1.4	1997	53	53	
	Subtotal		53	53	4.7
	Recreational total		**374**	**124**	**32.8**
GILLNET FISHERIES					
Dist. 115 drift gillnet	1.2	1995	188	112	
	1.3	1996	60	42	
	Subtotal		248	120	21.8
Dist. 111 drift gillnet	1.3	1996	53	52	
	Subtotal		53	52	4.6
	Gillnet total		**301**	**131**	**26.4**
TROLL FISHERIES					
NE Quadrant troll	1.2	1995	39	39	
	1.3	1996	132	68	
	1.4	1997	39	39	
	Subtotal		210	88	18.5
NW Quadrant troll	1.3	1996	64	64	
	Subtotal		64	64	
	Troll total		**275**	**108**	**24.1**
SEINE FISHERIES					
District 112 seine	1.1	1994	85	41	
	Subtotal		85	41	7.5
District 114 seine	1.1	1994	21	20	
	Subtotal		21	20	1.8
	Seine total		**106**	**46**	**9.3**
TOTAL ALL FISHERIES			**1,139**	**215**	

harvest was taken in the commercial drift gillnet fishery. The commercial troll fisheries harvested 41.4% of the age 1.3 fish. Most (77.6%) of the estimated age 1.4 harvest was taken in the recreational fisheries (Table 14).

A list of computer files used in this analysis is found in Appendix A5.

DISCUSSION

Several assumptions, as noted above, underlie our estimate of abundance. Considerable efforts were made to catch and mark fish in proportion to their abundance (assumption a) during the immigration by sampling uniformly across the escapement. Sampling effort for tags on the Kelsall and Tahini rivers (where >90% of spawning occurred in 1991 and 1992; Johnson et al. 1992, 1993), was fairly constant across the time when spawning fish die and are available for sampling. Previous research on the Chilkat River (Johnson et al. 1992, 1993) suggests immigration timing is similar for Tahini and Kelsall River stocks. Tagging ratios found on the Tahini ($p = 0.071$) and Kelsall-Nataga ($p = 0.055$) rivers in 1998 were similar. Although carcass surveys are known to be selective for females in some situations (Pahlke et al. 1996), I could not detect a significant difference from the battery of tests applied in this study. The assumption of no recruitment during the experiment is reasonable since tagging effort was relatively constant and continued until only about one fish a day was being caught. I could not test assumption that marking does not effect catchability directly; however, recovery rates of large fish marked in the gillnet ($p = 0.145$) were significantly different from those marked in the fish wheels ($p = 0.049$), ($\chi^2 = 3.874$, df = 1, $P = 0.049$). This suggests fish marked at the fish wheels may have had higher mortality than those captured in gillnets. However, the difference between the recapture rates could also result from poor tagging methods at the fish wheels, which were operated by less experienced technicians. Of the 32 marked fish recaptured, 5 were missing tags. If these fish were all marked at the fish wheel, recapture rates would be more similar ($p = 0.131$)

Table 14.–Estimated harvest of 1991 brood year Chilkat River chinook salmon by age class and fishery.

Age	Fishery	Harvest	SE	Percent
1.1	Seine	106	46	100
Age 1.1 subtotal		**106**	**46**	**9.3**
1.2	Subsistence	13	2	4.4
	Gillnet	188	112	64.5
	Sport	51	51	17.6
	Troll	39	39	13.5
Age 1.2 subtotal		**292**	**129**	**25.6**
1.3	Subsistence	49	1	10.4
	Gillnet	113	67	23.8
	Sport	115	59	24.3
	Troll	196	93	41.4
Age 1.3 subtotal		**473**	**129**	**41.6**
1.4	Subsistence	20	1	7.6
	Sport	207	97	77.6
	Troll	39	39	14.8
Age 1.4 subtotal		**267**	**104**	**23.4**
1.5	Subsistence	1	0.3	100.0
Age 1.5 subtotal		**1**	**0.3**	**0.1**
	TOTAL	1,139	215	

between the two gear types. Because all fish had secondary marks that were not lost, assumption (d) was satisfied. Personnel sampling on the spawning tributaries carefully examined each fish for marks; therefore failure of assumption (e) is unlikely.

The immigration timing of chinook salmon through the lower Chilkat River was about one week earlier than average. The mean date of migratory timing was June 25. In contrast, the mean date for past years is July 2 (Figure 4).

The 1998 immigration of 3,675 (SE = 565) is the lowest abundance estimated since 1991 (Table 15). This is the result of poor 1992 and 1993 brood year returns to the Chilkat River (Table 16).

Sex was estimated with some uncertainty early in the season. Two out of 28 tagged fish that were recaptured on the spawning grounds were sexed incorrectly during the marking event, as judged by sex determination on the spawning ground (where sexual dimorphism is more evident). However, these fish were nearly evenly split between males and females in 1998.

Sport fishing harvest patterns observed during 1998 were different those observed in recent years. During 1998, 59% of the estimated harvest of chinook salmon was landed at the Letnikof Dock. Since 1995, the harvest from this dock has averaged 79%. The proportion of the harvest increased at the Chilkat State Park boat launch from an average of 11% to 23% in 1998. It is unclear whether there was a real shift in harvest patterns or a result of chance encounters with a relatively high number of successful anglers at this low-use site.

The 1998 estimated harvest of large chinook salmon is lower than, but similar to, the harvest during the last eight years (1988, 1989, 1990, 1993, 1994, 1995, 1996 and 1997) the fishery was open (Table 17, Figure 7). Sport fishing effort was also similar to that observed in recent years. Catch of large chinook salmon per salmon hour of effort (CPUE) in 1998 was somewhat lower than that observed in recent years, and much lower than that observed during the mid-1980s (Table 17) when anglers were allowed to fish to the mouth of the river.

The harvest pattern of 1991 brood year Chilkat River chinook salmon in this study is similar to that observed in prior studies (Pahlke 1991, Johnson et al. 1993, Ericksen 1996). These fish are harvested primarily in the inside waters of northern Southeast Alaska. Over 95% of the harvest occurred in districts 111, 112, 114, and 115, with the Haines area (district 115) harvest exceeding 55%. The Haines spring recreational fishery harvests mature fish as they return to spawn. In contrast, the commercial gillnet fisheries tend to harvest this stock later in the season as immature fish.

The estimates of harvest produced in this study do not consider all potentially important sources of fishing mortality. The largest potential for undocumented harvest occurs in the district 115 gillnet fishery. Studies of the commercial drift gillnet fisheries in Taku Inlet (Joe Muir, Commercial Fisheries Division, retired, personal communication) and Lynn Canal

Table 15.–Parameters used to estimate abundance of large (≥age 1.3) chinook salmon to the Chilkat River, 1991–1998.

	1991[a]	1992[b]	1993[c]	1994[d]	1995[e]	1996[f]	1997[g]	1998
LOWER RIVER MARKING								
Drift gillnet	(5/22-7/19)	(6/01-7/23)	(6/15-7/22)	(6/14-7/22)	(6/13-7/21)	(6/11-7/22)	(6/12-7/20)	(6/12-7/18)
Marked	80	148	159	212	121	188	189	166
Fishwheels	(5/05-7/19)			(6/16-7/22)	(6/14-8/9)	(6/22-9/15)	(6/13-7/25)	(6/8-10/13)
Marked	145			84	59	45	128	61
Total marked	225	148	159	296	180	233	317	227
SPAWNING GROUND RECOVERIES								
Kelsall/Nataga	(8/06-9/05)	(7/29-9/04)	(8/09-9/05)	(8/04-9/03)	(8/06-9/04)	(8/06-9/05)	(8/04-9/02)	(8/02-9/05)
Captures	507	571	445	482	240	328	487	385
Recoveries	15	18	15	24	11	13	21	21
Tahini gillnet	(7/22-8/09)	(7/16-8/17)	(7/22-8/11)					
Captures	155	158	90					
Recoveries	9	4	4					
Tahini carcass[h]	(8/11-9/03)	(8/14-8/31)	(8/20-9/01)	(8/10-9/03)	(8/07-9/04)	(8/08-9/06)	(8/05-9/02)	(8/03-9/01)
Captures	39	156	43	250	84	257	400	112
Recoveries	2	1	1	5	4	14	13	8
Big Boulder	(8/05-9/12)	(7/31-8/15)	(8/04-8/10)	(8/03-8/19)	(8/04-9/05)	(8/09-9/03)	(8/07-8/22)	(8/06-9/02)
Captures	30	20	36	44	59	129	80	34
Recoveries	0	0	1	4	2	6	3	3
Total captures	733[i]	905	614	776	383	714	967	531
Total recoveries	27[i]	23	21	33	17	33	37	32
Abundance	5,897	5,284	4,472	6,795	3,790	4,920	8,100	3,675
SE	1,005	949	851	1,057	805	751	1,193	565
Rel. precision[j]	0.33	0.35	0.37	0.30	0.42	0.30	0.29	0.30

[a] From Johnson et al. (1992).

[b] From Johnson et al. (1993).

[c] From Johnson (1994).

[d] From Ericksen (1995).

[e] From Ericksen (1996).

[f] From Ericksen (1997).

[g] From Ericksen (1998).

[h] Sampling was not consistent at this site prior to 1994.

[i] Includes 2 fish captured and one recovered from tributaries not listed.

[j] Relative precision = 1.96 Standard Error/estimate.

Table 16.-Estimated annual age compositions [a] and brood year returns of large (≥age 1.3) chinook salmon immigrating into the Chilkat River, 1991–1998.

Return year		Age class 1.3	1.4	1.5	Total
1991	Abundance[b]	2,714	2,995	187	5,897
	SE	489	541	23	1,005
1992	Abundance[c]	1,689	3,595		5,284
	SE	309	662		949
1993	Abundance[d]	2,217	2,180	75	4,472
	SE	432	425	10	851
1994	Abundance[e]	2,405	4,276	115	6,795
	SE	382	681	15	1,057
1995	Abundance[f]	450	3,077	263	3,790
	SE	93	664	52	805
1996	Abundance[g]	4,077	788	54	4,920
	SE	632	120	6	751
1997	Abundance[h]	1,943	6,157		8,100
	SE	354	930		1,193
1998	Abundance	1,016	2,440	219	3,675
	SE	169	381	48	565
Avg.	Percent	38.5	59.4	2.1	
	Abundance	2,064	3,188	113	5,367

BROOD YEAR RETURNS

Brood year	Age class 1.3	1.4	1.5	Total	SE
1986	2,714	3,595	75	6,385	823
1987	1,689	2,180	115	3,983	525
1988	2,217	4,276	263	6,755	809
1989	2,405	3,077	54	5,536	766
1990	450	788		1,239	152
1991	4,077	6,157	219	10,453	1,126
1992	1,943	2,440		4,383	521
1993	1,016			1,016	169
Avg.	2,064	3,217	120	5,534	

[a] Estimated from pooled age samples of large chinook salmon from the drift gillnet and Tahini and Kelsall spawning grounds prior to the 1997 return.

[b] Data taken from Johnson et al. (1992).

[c] Data taken from Johnson et al. (1993).

[d] Data taken from Johnson (1994).

[e] Data taken from Ericksen (1995).

[f] Data taken from Ericksen (1996).

[g] Data taken from Ericksen (1997).

[h] Data taken from Ericksen (1998).

(Ericksen and Marshall 1997) indicate that the catch of chinook salmon in these fisheries is much higher than the reported harvest. Although some of these fish are released, many are retained for personal use, and the incidental mortality of those released is probably very high. Also, small chinook salmon caught in the seine fishery are not counted and rarely sampled. The estimated harvest of small chinook in the 1994 seine fishery was simply the total number sampled. Thus, our harvest estimates are biased low in this fishery. Finally, some sport fisheries in northern Southeast Alaska are not sampled for CWTs (e.g., Skagway, Hoonah, Gustavus, Tenakee, Elfin Cove, etc.). These fisheries surely harvest some Chilkat River chinook salmon.

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Table 17.–Estimated angler effort, and large (≥28 in.) chinook salmon catch and harvest in the Haines marine boat sport fishery for similar sample periods, 1984–1998.

Year	Survey dates	Effort				Large (≥28") chinook salmon				Catch per salmon-hour of effort
		All angler-hours	SE	Salmon-hours	SE	Catch	SE	Harvest	SE	
1984[a]	5/06-6/30	10,253	[b]	9,855	[b]	1,072	[b]	1,072	[b]	0.109
1985[c]	4/15-7/15	21,598	[b]	20,582	[b]	1,705	[b]	1,696	[b]	0.083
1986[d]	4/14-7/13	33,857	[b]	32,533	[b]	1,659	[b]	1,638	[b]	0.051
1987[e]	4/20-7/12	26,621	2,557	22,848	2,191	1,094	189	1,094	189	0.048
1988[f]	4/11-7/10	36,222	3,553	32,723	3,476	505	103	481	101	0.015
1989[g]	4/24-6/25	10,526	999	9,363	922	237	42	235	42	0.025
1990[h]	4/23-6/21	[h]	[h]	11,972	1,169	248	60	241	57	0.021
1993[I]	4/26-7/18	11,919	1,559	9,069	1,479	349	63	314	55	0.038
1994[j]	5/09-7/03	9,726	723	7,682	597	269	41	220	32	0.035
1995[k]	5/08-7/02	9,457	501	8,606	483	255	42	228	41	0.030
1996[l]	5/06-6/30	10,082	880	9,596	866	367	43	354	41	0.038
1997[m]	5/12-6/29	9,432	861	8,758	697	381	46	381	46	0.044
1998	5/11-6/28	8,200	811	7,546	747	222	60	215	56	0.029
1984–86 average		21,903		20,990		1,479		1,469		0.081
1987–90 average		24,456		19,227		521		513		0.027
1993–98 average		9,803		8,543		307		285		0.036

[a] Neimark (1985).
[b] Estimates of variance not provided until 1987.
[c] Mecum and Suchanek (1986).
[d] Mecum and Suchanek (1987).
[e] From Bingham et al. (1988).
[f] Suchanek and Bingham (1989).
[g] Suchanek and Bingham (1990).
[h] Suchanek and Bingham (1991); no estimate of total angler effort and harvest provided.
[i] Ericksen (1994).
[j] Ericksen (1995).
[k] Ericksen (1996).
[l] Ericksen (1997).
[m] Ericksen (1998).

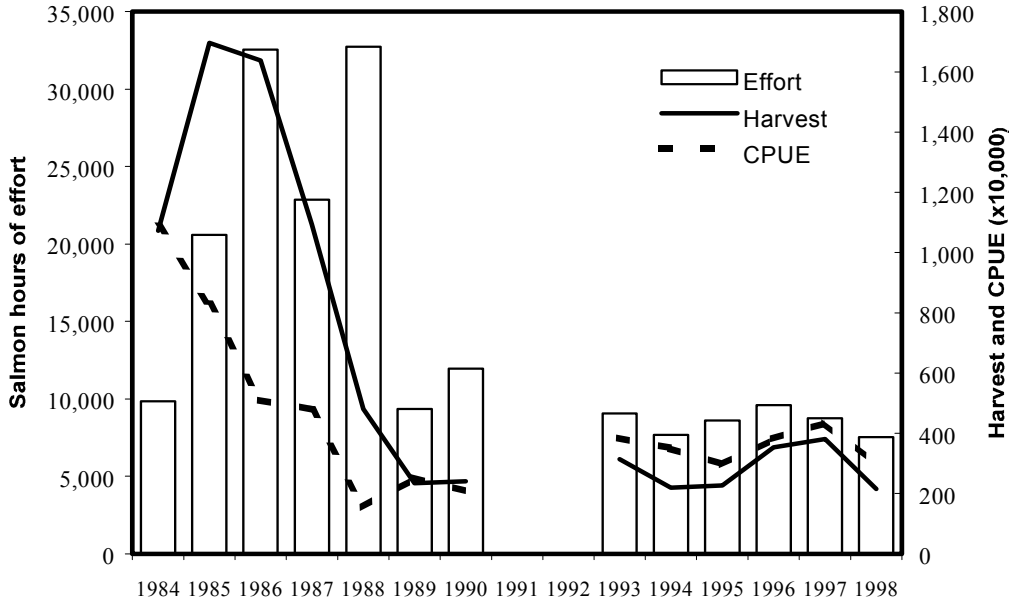

Figure 7.–Estimated angler effort for, and harvest and catch of large chinook salmon per salmon hour of effort (CPUE) in the Haines spring marine boat sport fishery, 1984–1998. Data taken from Table 17 (fishery closed in 1991 and 1992).

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APPENDIX A

Appendix A1.–Sampling statistics, estimated effort, catch, and harvest of chinook salmon at the Letnikof Dock by week, May 11 through June 28, 1998.

		May 18 - May 31						
	May 11 May 17	Non-derby	Derby	June 01 June 07	June 08 June 14	June 15 June 21	June 22 June 28	Total
Boats counted	25	23	69	69	43	25	5	259
Angler-hs. sampled	185	178	963	623	405	257	24	2,635
Salmon-hs. sampled	183	156	951	609	405	228	24	2,556
Chinook sampled	4	2	38	25	3	3	0	75
Sampled for ad-clips	4	2	38	25	3	3	0	75
Ad-clips	0	0	1	1	0	0	0	0
Angler-hours								
Estimate	244	541	2,406	1,070	652	628	60	5,601
Variance	3,746	48,027	141,710	35,739	24,896	47,376	464	301,958
Salmon-hours								
Estimate	241	475	2,376	1,035	652	560	60	5,399
Variance	3,742	36,915	151,205	32,169	24,896	33,121	464	282,512
Large chinook catch								
Estimate	9	6	41	56	6	8	0	126
Variance	34	6	8	1,074	9	21	0	1,152
Large chinook kept								
Estimate	9	6	41	56	6	8	0	126
Variance	34	6	8	1,074	9	21	0	1,152
Wild mature chinook kept (excluding hatchery and immature fish)								
Estimate	4	3	5	50	6	8	0	76
Variance	4	6	8	890	9	21	0	938
Small chinook catch								
Estimate	0	3	13	6	2	0	0	24
Variance	0	6	34	0	0	0	0	40
Small chinook kept								
Estimate	0	0	0	0	0	0	0	0
Variance	0	0	0	0	0	0	0	0

Appendix A2.–Sampling statistics, estimated effort, catch, and harvest of chinook salmon at the Chilkat State Park boat launch by biweek, May 18 through June 28, 1998.

	May 18 - May 31				
	Non-derby	Derby	June 01 June 14	June 15 June 28	Total
Boats counted	0	1	8	5	14
Angler-hs. sampled	0	12	79	60	151
Salmon-hs. sampled	0	12	73	36	121
Chinook sampled	0	0	5	2	7
Sampled for ad-clips	0	0	5	2	7
Ad-clips	0	0	0	0	0
Angler-hours					
Estimate	0	60	553	422	1,035
Variance	0	2,880	110,082	87,321	200,283
Salmon-hours					
Estimate	0	60	511	254	825
Variance	0	2,880	86,394	26,841	116,115
Large chinook catch					
Estimate	0	0	42	14	56
Variance	0	0	1,512	168	1,680
Large chinook kept					
Estimate	0	0	35	14	49
Variance	0	0	1,050	168	1,218
Wild mature chinook kept (excluding hatchery and immature fish)					
Estimate	0	0	35	14	49
Variance	0	0	1,050	168	1,218
Small chinook catch					
Estimate	0	0	0	7	7
Variance	0	0	0	42	42
Small chinook kept					
Estimate	0	0	0	0	0
Variance	0	0	0	0	0

Appendix A3.–Sampling statistics, estimated effort, catch, and harvest of chinook salmon at the Small Boat Harbor by biweek, May 11 through June 28, 1998.

		May 18–May 31				
	May 11 May 17	Non-derby	Derby	June 01 June 14	June 15 June 28	Total
Boats counted	7	5	5	7	12	36
Angler-hs. sampled	34	83	31	57	74	279
Salmon-hs. sampled	26	79	31	47	56	239
Chinook sampled	0	0	1	4	6	11
Sampled for ad-clips	0	0	1	4	6	11
Ad-clips	0	0	0	0	2	2
Angler-hours						
Estimate	120	371	156	399	518	1,564
Variance	9,967	107,198	1,051	29,442	8,232	155,890
Salmon-hours						
Estimate	92	353	156	329	392	1,322
Variance	5,802	97,055	1,051	55,482	672	160,062
Large chinook catch						
Estimate	0	0	5	28	7	40
Variance	0	0	20	672	42	734
Large chinook kept						
Estimate	0	0	5	28	7	40
Variance	0	0	20	672	42	734
Wild mature chinook kept (excluding hatchery and immature fish)						
Estimate	0	0	0	21	7	28
Variance	0	0	0	378	42	420
Small chinook catch						
Estimate	0	5	0	0	56	61
Variance	0	16	0	0	336	352
Small chinook kept						
Estimate	0	0	0	0	35	35
Variance	0	0	0	0	546	546

Appendix A4.–Random, select, and volunteer recoveries of 1990, 1991, and 1992 coded wire tagged Chilkat River chinook salmon, 1994–1997.

Tag code	Head number	Recovery date	Stat. week	Gear	Survey site	District	Sub-dist.	Length	Facility	Release site
1990 Brood year random recoveries										
401010913	30305	07/06/94	28	Gillnet	Excursion Inlet	115		605	Jerry Myers	Tahini
401011014	99308	05/27/95	21	Sport	Haines	115	32	700	Jerry Myers	Tahini
401011014	99325	08/14/95	33	Escapement	Tahini	115	32	815	Jerry Myers	Tahini
401010913	99352	08/17/95	33	Escapement	Tahini	115	32	745	Jerry Myers	Tahini
1990 Brood year select recoveries										
401010913	99314	06/08/95	23	Sport	Haines	115	32		Jerry Myers	Tahini
1991 Brood year random recoveries										
401020602	3551	07/02/94	27	Escapement	Tahini	115	32	400	Gastineau	Tahini
401020602	3553	07/02/94	27	Escapement	Tahini	115	32	400	Gastineau	Tahini
401020603	3552	07/02/94	27	Escapement	Tahini	115	32	410	Gastineau	Tahini
401020601	30121	07/05/94	28	Seine	Excursion Inlet	112		374	Gastineau	Big Boulder
401020601	30724	07/25/94	31	Seine	Excursion Inlet	112		428	Gastineau	Big Boulder
401020603	31288	08/01/94	32	Seine	Excursion Inlet	114	27	424	Gastineau	Tahini
401020602	3508	08/10/94	33	Escapement	Tahini	115	32	435	Gastineau	Tahini
401020602	31949	08/18/94	34	Seine	Excursion Inlet	112	16	412	Gastineau	Tahini
401020603	3521	08/20/94	34	Escapement	Tahini	115	32	410	Gastineau	Tahini
401020602	97051	08/24/94	35	Seine	Excursion Inlet	112	16	444	Gastineau	Tahini
401020602	3543	08/27/94	35	Escapement	Tahini	115	32	325	Gastineau	Tahini
401020602	99330	06/15/95	24	Sport	Haines	115	32	777	Gastineau	Tahini
401020603	40948	06/20/95	25	Gillnet	Petersburg	115		680	Gastineau	Tahini
401020602	40636	06/27/95	26	Gillnet	Petersburg	115		756	Gastineau	Tahini
401020603	82110	07/12/95	28	Gillnet	Hoonah	115	10	682	Gastineau	Tahini
401020603	99319	07/21/95	29	Escapement	Tahini	115	32	640	Gastineau	Tahini
401020601	76983	08/04/95	31	Escapement	Big Boulder	115	32		Gastineau	Big Boulder
401020603	99355	08/22/95	34	Escapement	Tahini	115	32	635	Gastineau	Tahini
401020510	99385	09/05/95	36	Escapement	Big Boulder	115	32	640	Gastineau	Big Boulder
401020601	18636	11/11/95	45	Troll	Juneau				Gastineau	Big Boulder
401010911	10630	06/01/96	22	Sport	Haines	115	32	780	Gastineau	Big Boulder
401020603	32043	06/01/96	22	Troll	Hoonah	112	12	728	Gastineau	Tahini
401010911	10612	06/02/96	23	Sport	Haines	115	32	855	Gastineau	Big Boulder
401010911	43804	06/03/96	23	Troll	Petersburg	112	22	770	Gastineau	Big Boulder
401020602	36623	06/18/96	25	Troll	Sitka	112	22	860	Gastineau	Tahini
401020602	10637	06/20/96	25	Sport	Haines	115	32	820	Gastineau	Tahini
401020510	32131	06/21/96	25	Troll	Hoonah	112	12	718	Gastineau	Big Boulder
401020601	17057	06/26/96	26	Gillnet	Petersburg	111		771	Gastineau	Big Boulder
401020602	10640	06/29/96	26	Subsistence	Haines	115	32		Gastineau	Tahini
401020602	32186	07/03/96	27	Troll	Hoonah	114	25		Gastineau	Tahini
401020602	30643	08/07/96	32	Gillnet	Excursion Inlet	115		872	Gastineau	Tahini
401020603	18507	08/07/96	32	Gillnet	Petersburg	115		800	Gastineau	Tahini
401020510	10702	08/09/96	32	Escapement	Big Boulder	115	32	800	Gastineau	Big Boulder
401020601	10701	08/09/96	32	Escapement	Big Boulder	115	32	750	Gastineau	Big Boulder
401010911	10704	08/13/96	33	Escapement	Big Boulder	115	32	785	Gastineau	Big Boulder
401020510	10705	08/13/96	33	Escapement	Big Boulder	115	32	825	Gastineau	Big Boulder

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Tag code	Head number	Recovery date	Stat. week	Gear	Survey site	District	Sub-dist.	Length	Facility	Release site
401020601	10706	08/13/96	33	Escapement	Big Boulder	115	32	760	Gastineau	Big Boulder
401020601	10703	08/13/96	33	Escapement	Big Boulder	115	32	850	Gastineau	Big Boulder
401010911	10712	08/14/96	33	Escapement	Big Boulder	115	32	750	Gastineau	Big Boulder
401010911	10713	08/14/96	33	Escapement	Big Boulder	115	32	810	Gastineau	Big Boulder
401010911	10715	08/14/96	33	Escapement	Big Boulder	115	32	820	Gastineau	Big Boulder
401020510	10717	08/14/96	33	Escapement	Big Boulder	115	32	855	Gastineau	Big Boulder
401020601	10707	08/14/96	33	Escapement	Big Boulder	115	32	820	Gastineau	Big Boulder
401020601	10714	08/14/96	33	Escapement	Big Boulder	115	32	820	Gastineau	Big Boulder
401020601	10716	08/14/96	33	Escapement	Big Boulder	115	32	855	Gastineau	Big Boulder
401020602	10638	08/14/96	33	Escapement	Tahini	115		735	Gastineau	Tahini
401020602	10639	08/14/96	33	Escapement	Tahini	115		800	Gastineau	Tahini
401020602	61208	08/16/96	33	Sport	Juneau	111	50	735	Gastineau	Tahini
401020603	10641	08/18/96	34	Escapement	Tahini	115	32	790	Gastineau	Tahini
401020602	10642	08/19/96	34	Escapement	Tahini	115	32	830	Gastineau	Tahini
401020603	10643	08/20/96	34	Escapement	Tahini	115	32	870	Gastineau	Tahini
401010911	10722	08/22/96	34	Escapement	Big Boulder	115	32	745	Gastineau	Big Boulder
401010911	10718	08/22/96	34	Escapement	Big Boulder	115	32	775	Gastineau	Big Boulder
401010911	10719	08/22/96	34	Escapement	Big Boulder	115	32	775	Gastineau	Big Boulder
401010911	10720	08/22/96	34	Escapement	Big Boulder	115	32	775	Gastineau	Big Boulder
401010911	10711	08/22/96	34	Escapement	Big Boulder	115	32	810	Gastineau	Big Boulder
401010911	10710	08/22/96	34	Escapement	Big Boulder	115	32	815	Gastineau	Big Boulder
401020510	10721	08/22/96	34	Escapement	Big Boulder	115	32	810	Gastineau	Big Boulder
401020601	10723	08/22/96	34	Escapement	Big Boulder	115	32	745	Gastineau	Big Boulder
401020602	10662	08/25/96	35	Escapement	Tahini	115	32	765	Gastineau	Tahini
401020602	10663	08/26/96	35	Escapement	Tahini	115	32	680	Gastineau	Tahini
401020602	10664	08/27/96	35	Escapement	Tahini	115	32	870	Gastineau	Tahini
401020602	10665	09/01/96	36	Escapement	Tahini	115	32	845	Gastineau	Tahini
401020601	10724	09/03/96	36	Escapement	Big Boulder	115	32	810	Gastineau	Big Boulder
401020602	252	05/25/97	22	Sport	Haines	115	32	1120	Gastineau	Tahini
401020603	255	05/31/97	22	Sport	Haines	115	34	860	Gastineau	Tahini
401020602	256	06/01/97	23	Sport	Haines	115	32	1005	Gastineau	Tahini
401020602	98398	06/01/97	23	Sport	Anchor Pt.	244	70	890	Gastineau	Tahini
401020601	266	06/16/97	25	Sport	Haines	115	32	900	Gastineau	Big Boulder
401020603	15024	06/20/97	25	Troll	Hoonah	112	12	918	Gastineau	Tahini
401020602	326	08/05/97	32	Escapement	Tahini	115	32	820	Gastineau	Tahini
401020602	327	08/07/97	32	Escapement	Tahini	115	32	1000	Gastineau	Tahini
401020602	328	08/10/97	33	Escapement	Tahini	115	32	905	Gastineau	Tahini
401020602	364	08/11/97	33	Escapement	Kelsall	115	32	890	Gastineau	Tahini
401020510	366	08/12/97	33	Escapement	Big Boulder	115	32	870	Gastineau	Big Boulder
401020601	362	08/12/97	33	Escapement	Big Boulder	115	32	880	Gastineau	Big Boulder
401020602	330	08/15/97	33	Escapement	Tahini	115	32	870	Gastineau	Tahini
401020603	331	08/15/97	33	Escapement	Tahini	115	32	1020	Gastineau	Tahini
401010911	359	08/21/97	34	Escapement	Big Boulder	115	32	810	Gastineau	Big Boulder
401020603	304	08/28/97	35	Escapement	Tahini	115	32	850	Gastineau	Tahini

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Tag code	Head number	Recovery date	Stat. week	Gear	Survey site	District	Sub-dist.	Length	Facility	Release site
1991 BROOD YEAR SELECT RECOVERIES										
401020601	10631	06/09/96	24	Sport	Haines	115	32	825	Gastineau	Big Boulder
401020603	10623	06/11/96	24	Sport	Haines	115	32		Gastineau	Tahini
1991 BROOD YEAR VOLUNTARY RECOVERIES										
401020601	12620	06/09/96	24	Sport	Jerry Myers	115	34	610	Gastineau	Big Boulder
401020601	113462	07/11/97	28	Sport	Jerry Myers	115	34		Gastineau	Big Boulder
1992 BROOD YEAR RANDOM RECOVERIES										
401020911	10709	08/22/96	34	Escapement	Big Boulder	115	32	670	Gastineau	Big Boulder
401020911	357	08/14/97	33	Escapement	Big Boulder	115	32	725	Gastineau	Big Boulder
401020911	300	08/14/97	33	Escapement	Big Boulder	115	32	760	Gastineau	Big Boulder
401020911	358	08/14/97	33	Escapement	Big Boulder	115	32	865	Gastineau	Big Boulder
401020911	33338	05/21/98	21	Troll	Petersburg	109	51	847	Gastineau	Big Boulder
401020911	316	06/03/98	23	Sport	Haines	115	32	980	Gastineau	Big Boulder
401020911	371	08/20/98	34	Escapement	Big Boulder	115	32	890	Gastineau	Big Boulder
401020911	343	08/25/98	35	Escapement	Big Boulder	115	32	845	Gastineau	Big Boulder
401020911	349	08/25/98	35	Escapement	Big Boulder	115	32	880	Gastineau	Big Boulder
401020911	344	09/02/98	36	Escapement	Big Boulder	115	32	790	Gastineau	Big Boulder

Appendix A5.–Computer data files used in the analysis of this report.

FILE NAME	DESCRIPTION
F2008100M011998.DTA	Mark-sense ASCII file containing angler interview data from the Haines marine sport fishery in 1998.
HAINE.PRG	Dbase program to generate SAS data file from mark-sense file.
HAINESCT.PRN	Count file (text) used in HAMC98.SAS to expand for missing interview data.
HAMC98.SAS	SAS program to estimate effort and harvest in the Haines marine sport fishery using HAINESCT.PRN and output from HAINE.PRG.
98SPORTAWL.XLS	Excel workbook containing all age-length data from the Haines sport fishery during 1998.
98POPEST.XLS	Excel workbook used to estimate 1998 abundance of Chilkat River chinook.
98SPAWN.XLS	Excel workbook containing raw data from chinook sampled on the Chilkat River spawning tributaries during 1998.
98TAGS.XLS	Excel workbook containing raw data from chinook captured in the lower Chilkat River during 1998.
CWT_RECS.XLS	Excel workbook containing cwt recoveries and expansions of 1990, 1991, and 1992 brood year Chilkat River chinook salmon.
RUNRECON.XLS	Excel workbook used to estimate the number of large chinook salmon in the 1998 Chilkat River escapement by age and sex.